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The Experimental Analysis of Social Behavior

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The Experimental Analysis of Social Behavior

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The Experimental Analysis of Social Behavior

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Preface

The traditional field of social psychology has much to gain from the methodology and outlook peculiar to the experimental study and analysis of behavior. The psychologist committed to the analysis of behavior should not abandon his point of view when he teaches a course in social psychology. Nor should a lack of textual material produce a corresponding gap in the student's understanding of behavioral analysis and control. Accordingly, this volume was prepared primarily to make the results of the experimental analysis of social behavior available to students. The interstitial material, in particular, was designed to facilitate use of the selections by students. In addition, the editors hope the collection will be useful on a professional level.

For their help in preparing the manuscript the editors wish to thank Sylvia Dulaney and Thomas Kucera. Marjorie Mountjoy and Kay Mueller made many suggestions which greatly improved the form and content of this volume. For their clerical help, thanks are due to Lois Speck and Lois Martin.

The main contribution of this book was made by the researchers who have plunged into a relatively new and unstructured field. The editors wish especially to thank the contributors for their permission to reprint their work, and, in many cases, for supplying material necessary to the reproduction of illustrations. Hopefully the work of the contributors will, as sound experimental work generally does, stimulate further forays into the experimental analysis of social behavior.

R.E.U.
P.T.M.

Contents

The Experimental Analysis of Social Behavior

INTRODUCTION

Of all the components of his environment, man would do best to understand himself. Man, as he exists in his natural environment, both emits stimuli and responds to stimuli emitted by others. The behavior of one person, created in part by his fellows, acts in turn as a stimulus which determines the behavior of others. The most important part of understanding man's nature is to understand the behavior he emits, both as a stimulus for other organisms and as a response to stimuli emitted by other organisms. From birth, social stimuli are the most effective part of an individual's environment. The behavior of groups is determined almost entirely by social interactions both internal and external to the group. Whatever man accomplishes to enhance his experience as a human organism will probably be achieved primarily through human social interaction; if man as a species disappears, human social interaction will probably be a crucial factor contributing to his demise.

The experimental analysis of behavior in both human and nonhuman organisms provides the most solid basis possible for the scientific understanding of human social interactions. In order to truly understand behavior, one must be able to describe the environment in which that behavior develops, is maintained, or is abolished. Understanding behavior involves its prediction and control. Our cultural institutions are demanding a type of understanding and control of social phenomena that only behavioral scientists are able to offer. Approaches to social behavior relying heavily upon such methods as verbal reports, attitude scales, and projective techniques have not produced the type of understanding and control of social phenomena that our culture demands. Recent advances in the study of behavior have made possible valid experimental analyses of the subtleties of behavioral situations involving more than one organism. More and more behavioral scientists are undertaking the experimental analysis of behaviors such as cooperation, competition, imitation, aggression, and affection. The present selection and consolidation of the most effective experimental approaches to the study of social behavior is an outgrowth of these efforts.

Terms such as "the analysis of behavior" and "behavior analysis" describe an approach to the study of behavior that has been successfully used to study the behavior of individual organisms. The basic concepts and methodology of behavior analysis were originated by Skinner (1938). An animal is placed into a skeletal, controllable environment, popularly known as a "Skinner box," providing for simple, definable, measurable response from the organism, and for equally simple, definable, controllable stimuli from the environment. The stimuli presented by the environment are basically of three types: (1) *reinforcers*—stimuli that increase the probability that the response they follow will reoccur; (2) *aversive stimuli*—stimuli that decrease the probability that the response they follow will reoccur; and (3) *discriminative stimuli*, or S^D's—stimuli that precede the response and indicate to the organism which consequence will follow the response. These types of stimuli are used to control certain characteristics of behavior such as rate of response (the number of responses emitted in a given length of time). Three basic procedures are employed by the experimenter to control the behavior of subjects: (1) *reinforcement*—a process that increases the frequency of a response by following it with a reinforcer; (2) *punishment*—a process that decreases the frequency of a response by following it with an aversive stimulus; and (3) *extinction*—a process that decreases the frequency of the response by following it with neither reinforcement nor punishment (for further discussion see Skinner, 1953; Holland and Skinner, 1961; Michael and Myerson, 1966; Reynolds, 1968).

Reinforcement may follow every response or occur intermittently. The procedure which follows every response with reinforcement is known as *continuous reinforcement*, or *crf*. Continuous reinforcement is useful in establishing responses and in maintaining newly-established responses. Intermittent reinforcement may occur on *ratio* or on *interval schedules*, both of which may be *fixed* or *variable*. In ratio schedules a certain percentage of the responses are reinforced. In *fixed-ratio* (*FR*) *schedules* the same number of responses must always occur between reinforcements. For example, on a FR 10, every tenth response is reinforced. In *variable ratio* (*VR*) *schedules*, the number of responses between reinforcements varies. On one occasion, the second response after a previous reinforcement may be reinforced; on another, the fifteenth may be reinforced. In interval schedules, the first response after a certain interval of time is reinforced. In *fixed-interval* (*FI*) *schedules*, the interval is constant. Perhaps after one minute, a response is reinforced. When the reinforced response has been made, a timer resets and allows another one-minute interval to elapse before another response may be reinforced. In *variable-interval* (*VI*) *schedules*, the amount of time allowed to elapse between reinforced responses is varied randomly, within limits set by the experimenter.

Each schedule of reinforcement produces a characteristic behavioral performance in individual organisms in a mechanical environment. Continuous

reinforcement produces a moderate, steady rate of response. Fixed-ratio schedules produce a high rate of response interspersed with a pause after each reinforcement. Variable-ratio reinforcement produces a moderately high, steady rate of response. Responses maintained by variable-ratio reinforcement are especially resistant to extinction. Fixed-interval reinforcement generates a performance which, after each reinforcement, begins at a low rate and accelerates until it reaches a very high rate just before the next reinforcement is due. Variable-interval reinforcement produces a high, steady rate of response.

A prototype for the experimental approach is provided by the typical apparatus used to study the behavior of pigeons. It consists of a soundproof experimental chamber, containing one or more keys which can be pecked by the bird. The experimental chamber also contains a feeder which dispenses food (a reinforcer), and may contain a mechanism which dispenses shock (an aversive stimulus). In addition, various colored lights can be provided, usually behind the response keys (these lights are the discriminative stimuli). Perhaps food will only follow responses when a red light is on, or perhaps responses will be followed by food only when the red light is on and by shock when a green light is on. In both cases, nearly all of the pigeon's responses will occur when the red light is on.

The rate of responding is recorded automatically on a device known as a cumulative recorder, and consisting of a roll of paper unwound at a given speed and a fixed pen that makes a continuous line, beginning near one edge of the paper. When a response is made, the pen is deflected a certain distance perpendicular to the edges of the paper. Thus, time is measured along the length of the paper, and the number of responses is recorded, cumulatively, across it. The slope of the resulting line indicates the rate of response. An organism emitting no responses will produce a straight line which runs parallel to the edges of the paper. An organism responding at a very high rate will produce a line much more like a line drawn across the paper. Changes in rate of response can produce bumps or scallops in the record. When the recorder, in accumulating responses, reaches the other edge of the paper, it resets near the opposite edge. Administration of reinforcers and aversive stimuli is often recorded by the pen briefly shifting backward, producing a "hatch mark" off the line of the record. The cumulative recorder not only allows automatic recording of the behavior but produces a fine, detailed record that is convenient to analyze (for further discussion of methodology see Holland and Skinner, 1961; Sidman, 1961; Reynolds, 1968).

With such experimental arrangements, the behavior of organisms can be given long-term, detailed analysis. The results are reliable, reproducible, and provide a secure understanding of the environmental factors that produce

certain behavior. No attempt is made to mask irregularities in performance by lumping together data from many subjects. The behavior of each organism is controlled and understood in itself. The method of behavior analysis has produced spectacular results: pigeons have been taught to track missiles (Skinner, 1960), inspect parts on assembly lines (Cumming, 1966; Verhave, 1966b), play ping pong (Skinner, 1962), and recognize photographs of people (Herrnstein and Loveland, 1964). Human organisms have been taught to speak (Risley and Wolf, 1966), study (Fox, 1962; Goldiamond, 1965), lose weight (Goldiamond, 1965), and get along with their wives (Goldiamond, 1965). More important than the applications, however, is the understanding provided by the method of how the environment affects the behavior of organisms (e.g. Honig, 1966; Verhave, 1966a; Cantania, 1968). To date, most efforts on the part of psychologists have been directed toward understanding the behavior of organisms as individuals reacting to a mechanical environment. However, as the contents of this volume will show, the method is equally applicable to social behavior.

Skinner (1953, p. 297) has defined social behavior as "the behavior of two or more (organisms) with respect to one another or in concert with respect to a common environment." In the context of the experimental environment described above, another organism may replace the mechanical apparatus, or two or more organisms may behave within the mechanical environment. The behavior of a single organism in relation to a mechanical environment is rather well understood. But what will be the effect of introducing non-mechanical, living stimuli into that environment? In short, what is the nature of social experience?

One school of thought holds that social situations are fundamentally different from nonsocial situations (discussed by Cohen and Lindsley, 1964, p. 119). Perhaps this view is related to that of the vitalists, who maintained that living matter possessed properties fundamentally different from, and not subject to, the natural laws controlling nonliving matter. However, it is difficult for the behavior analyst to believe that reinforcers will not continue to strengthen responses, that aversive stimuli will not continue to punish, and that discriminative stimuli will not continue to function as cues, whether the situation is social or nonsocial. Certainly, social stimuli are powerful and complex. However, at the present time there is no reason to believe that the power and complexity of social stimuli are not acquired in the same way that other stimuli acquire power and complexity—through repeated, complex association with other powerful stimuli.

This volume, then, presents studies of social behavior which use the methods of experimental analysis to achieve understanding and control of social behavior. In some areas, analogous experiments using nonhuman and human

subjects are presented; in others, only experiments using nonhuman subjects are as yet available. In their chapter on the social significance of animal studies, Hebb and Thompson (1954) advise their readers not to think that it is a social error to be found with a copy of the *Journal of Comparative and Physiological Psychology* in hand. They argue that the behavior of nonhuman animals is a significant source of information for the solution of social problems that involve human animals. Because lower animals exhibit many of the characteristics observed in human beings, infrahuman organisms constitute a population for experimentation that could not occur were it to await investigation using human subjects. For example, nonhuman animals have been used to study the effect of extremely aversive stimulation on aggressive responses (Ulrich, 1966, 1967; Ulrich, Hutchinson, and Azrin, 1965). Such research would not be possible using human subjects. Obviously there are differences between the behavior of pigeons and of human beings, yet analyses of the individual behavior of nonhuman subjects have been found to be applicable to human subjects as well (e.g. Holland, 1958). It is better to assume that the social behavior of human animals will follow the same general laws as the social behavior of nonhuman animals, than to assume new "causes" unproved under any circumstances.

The selections begin with the most basic treatments of social behavior and move gradually to topics of more traditional interest. A more desirable approach would begin with studies of the basic elements of social behavior in simple experimental environments and then move on to study more complex forms of social behavior from the same point of view. However, the work has not yet been done, and the organization of the book has been adapted to the topical approach of the existing literature. In each chapter, an attempt has been made to select work which features sound experimental methodologies and which attempts to achieve a detailed understanding of the behavior. Where possible, statistical and descriptive treatments have been avoided. Many of the selections contain useful information in themselves; others suggest future work. The editors feel that all represent the best current approaches to their subjects.

Studies of topics such as cooperation, competition, leadership, authority, altruism, and imitation show how the techniques of behavior analysis can be applied to social behavior. These studies explore the conditions that produce the social behaviors and examine the interaction of the behavior of one organism, not only with the nonliving environment, but also with the behavior of other organisms. Topics such as social reinforcement and social facilitation examine the effects of social discriminative stimuli on behavior. Studies of aggression, affection, and attendant topics provide insight into the "social emotions." Early social experience, verbal behavior, social organization, and disordered social behavior are more traditional in interest, yet the selections

are oriented, insofar as possible, to the kind of detailed understanding demanded by behavior analysis. The final chapter on the cultural control of social behavior treats the possibilities and problems that come up with increased understanding and control of social behavior.

To date, man has been notably unsuccessful in controlling his own social behavior. Social problems are as abundant as are both his ignorance of their causes and his efforts to control them. His society has police forces, prisons, armies, commissions on violence, commissions on international cooperation, groups that deal with inequalities of social organization, courts, labor unions, innumerable publications on child rearing and other social relationships, people in the streets preaching love, and tens of thousands of sociologists and psychologists. The machinery for social change is abundant. The fault lies in misapplication of resources. Unproved and unprovable theories, as well as wishful thinking, have been called in to fill vacancies in knowledge. A good scientific understanding of the causes and control of individual behavior already exists, although much is lacking in its application. It is time to systematically develop and apply a rigorous scientific understanding of the factors controlling social behavior.

There is today a growing concern not only over the possibility of the control of human social behavior, but over the ethics of such control. The powerful techniques produced by the science of behavior, if not properly used, might cause men to behave in ways they abhor. In fact, social agencies are already controlling the behavior of individuals. However, the control relies heavily on the use of aversive stimuli, and it more often than not malfunctions. Concern for the possible misuse of behavior control should not lead to the rejection of advances in knowledge and technology. The answer lies in a better understanding of the complexities of social behavior, including the etiology of values. Then can man's resources not only be used more efficiently, but directed toward making human experience as exciting and satisfying as possible.

Certainly, the planning necessary for establishing a more pleasant society must be based upon a better understanding of the principles of social interaction. These principles have emerged and will emerge from the research efforts of numerous scientists whose publications are not represented in this volume, as well as those whose reports have been included. We feel that the selections and the commentary herein presented will provide the reader with a clearer picture of the factors that control man's social behavior. Hopefully the reader will then seek and perhaps himself produce further examples of experimental analysis of social behavior, so that a fuller understanding of man's social behavior may be achieved.

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1

COOPERATION, COMPETITION, AND LEADERSHIP

Cooperation, competition, and leadership are three relationships of great importance to human social experience. Cooperation seems to be widely desired. Nations as well as individuals are urged to cooperate with one another, yet little is known of the factors that actually produce cooperation. Competition may be unavoidable in a world whose ratio of resources to population is low and constantly shrinking. An understanding of the conditions that make competition a workable, acceptable social relationship would be invaluable. Effective leadership can insure group behavior maximizing reinforcement for all members. The study of cooperation, competition, and leadership exemplifies the experimental analysis of social behavior. In the research papers presented in this chapter, an experimental definition of the behaviors is given, and a rigorous experimental apparatus and procedure are used. The results, although as yet sparse, provide a basis for a better understanding and control of cooperation, competition, and leadership.

The first selection, "Two 'synthetic social relations,'" reports two well-known studies by B. F. Skinner. In the first study, or "relation," the subjects, two pigeons, were taught to play a famous game of ping pong. The ping pong apparatus was, of course, modified to suit the pigeons, but conditions similar to a human game applied. Both birds were required to bat the ball across a "table." When one bird missed a shot, the other was reinforced with food. In the second relation, two pigeons, separated by a plexiglas partition, were required to peck matching pairs of keys nearly simultaneously. When they responded successfully, both were reinforced.

The second relationship provides a definition of cooperation which is now used in the experimental analysis of social behavior: In cooperation, two or more organisms respond to provide reinforcement for all of the responding organisms. Unless both (or all) organisms respond, neither (or none) will be

reinforced. Similarly, the ping pong game provides a definition of competition: In competition, two or more organisms respond, but only one or some of them (the "winner" or "winners") is reinforced.

Skinner's cooperative relationship is an exacting one. Not only must the pigeons peck matching keys nearly simultaneously, but they must first locate the one of three pairs of keys which will currently provide reinforcement. The operative pair, of course, is changed in a random order. The success with which the pigeons learned this behavior indicates that cooperation, even in demanding situations, can be produced and maintained by reinforcement.

In locating the operative pair of keys, one pigeon would consistently peck first, the other pigeon following closely and matching the first's response. A definition of leadership is thereby provided: When two or more organisms respond to provide reinforcement for one or all, the leader is the organism which responds first. The leader's response provides a discriminative stimulus that makes successful response by the other organism(s) possible. In the case used by Skinner, the leader's response told the follower both which key to peck and when to peck it. Without the strong leader-follower relationship, successful cooperation in the complex task would have been impossible; in fact, the leader-follower relationship developed into strong imitative behavior that generalized to responses other than the cooperative one. Also, the hungrier, or more motivated, bird tended to become the leader. The study of the conditions which make a leader has hardly begun. An approach such as Skinner's, however, should provide a solid basis for future investigation.

The competitive ping-pong game likewise shows that competition is viable. However, Skinner encountered a problem which he described as "ratio strain." Because of their lack of skill, the pigeons would occasionally receive so little reinforcement that their behavior would deteriorate. Skinner corrected this problem by increasing the deprivation of the pigeons. Each reinforcement then became more powerful, and even infrequent reinforcement was able to maintain the behavior. A human ping-pong player with an unskilled partner who is about to give up because of scoring too few points may let the partner score occasionally in order to keep him playing. Competitive situations in which continued participation by the loser is necessary for future reinforcement of the winner take on a cooperative aspect. In the case of the pigeons, the ongoing food reinforcement was more important than any final "win." Continuing competitive responses by both players were necessary to prevent starvation. Although each individual instance of reinforcement was competitive, the overall situation was cooperative in that both pigeons had to receive some reinforcement for the game to continue.

Such "cooperative competition" is the subject of the second selection, by N. H. Azrin and O. R. Lindsley and entitled, "The reinforcement of coopera-

tion between children." The response is a matching response similar to, but not as demanding as, the cooperative response required of Skinner's pigeons. The subjects were groups of two children each. Each response produced reinforcement for only one of the two subjects. The situation was competitive, but, like the ping-pong game, it had a cooperative aspect. In order for either subject to receive future reinforcement, responses from both subjects were required. Some provision needed to be made by the winner to keep the loser responding. In Azrin and Lindsley's experiment, the subjects were human and they were able to converse during the experiment. Most pairs of subjects quickly made a verbal agreement to alternately divide the reinforcements. Azrin and Lindsley thus produced a situation in which competition was transformed by the subjects into an essentially cooperative situation. This sort of transformation is like turning water into wine. Limited reinforcements make universal reinforcement for social behavior impossible. When all participating subjects cannot be reinforced, and a continuation of the social behavior is desired, an alternating distribution of the reinforcements could be used to maintain the behavior. It is not surprising that behavior can be thus maintained; both subjects are actually being reinforced, although on an intermittent rather than a continuous schedule of reinforcement. In fact, most intermittent schedules of reinforcement will produce a higher rate of response more resistant to extinction than will continuous reinforcement (Holland and Skinner, 1961).

Azrin and Lindsley's experiment shows that competition can indeed be transformed into cooperation. However, a question still remains: What will happen when the continuing participation of the loser is unnecessary for the winner to receive reinforcement? Would the winning animal arrange for the reinforcement of the loser? Probably not. There is comfort, however, in the fact that human society is not so simple. Seldom is any reinforcement available on the long term without the participation of other human organisms. These continuing relationships can be very complicated and they no doubt break down in many cases. However, if ways can be found to make the cooperative aspects of competitive situations more salient, the more extreme forms of competition could be reduced. A better distribution of the reinforcements available in our world would result. Idealists have long stressed the interdependence of human beings and the desirability of cooperation to bring maximum happiness to all. Experiments such as Skinner's and Azrin and Lindsley's suggest that some real basis may exist for designing a society in which these ideals may in fact be achieved.

The experiments by Skinner and by Azrin and Lindsley use the traditional methods of operant conditioning for a study of simple instances of social behavior. The final selection uses a similar arrangement to study the extra-experimental social relationships of a child. The study by D. J. Cohen is

entitled, "Justin and his peers: An experimental analysis of a child's social world." Cohen attempts to relate the experimental definitions given above for cooperation, competition, and leadership to the definitions for those terms commonly used in our culture. Will two "cooperative" people actually emit responses at a high rate to obtain reinforcement for both? Will two "competitive" people approach the experimental competitive situation as an opportunity to obtain exclusive reinforcement, rather than to transform competition into cooperation as did Azrin and Lindsley's subjects? Will a "good leader" really respond first?

The apparatus used by Cohen was adapted from one commonly used to study nonsocial human behavior; it features an isolated chamber, a recording device, a response operandum, stimulus lights, and a mechanism for reinforcement of each subject. The two chambers are separated by a plexiglas partition that may or may not be exposed to make the subjects visible to one another. The stimulus lights in each chamber may indicate responses and reinforcement received by the other subject. The apparatus has been used to study the effects of human versus mechanical discriminative stimuli on cooperation (Cohen and Lindsley, 1964), and it should be useful for many analytical purposes.

The subjects in Cohen's study were a 13-year-old boy named Justin, his mother, his sister, his brother, his friend, and a stranger. Cooperative responses were defined much as they were in Skinner's and in Azrin and Lindsley's studies. When both subjects responded nearly simultaneously, both were reinforced. In all cases, Cohen produced cooperation, yet the success with which the subjects cooperated correlated with their extra-experimental "cooperativeness."

An attempt was also made to control leadership by reinforcing both subjects only when a certain subject responded first. Again, in all cases, the differential reinforcement did effectively control leadership. However, in the case of subjects accustomed to "leading" Justin in nonexperimental situations, that control was more difficult to achieve.

Cohen's competitive requirement was complex. The first subject to respond (the leader) was reinforced only when the other subject delayed his subsequent responses by more than .5 seconds. If the follower responded almost immediately after the leader, only the follower was reinforced. In most cases, the competitive relationship was transformed, as above, into a form of cooperation. However, in the case of his sister, with whom Justin had an especially competitive extra-experimental relationship, the situation remained essentially competitive. In "cooperative competition," leadership alternated between subjects. When the situation remained truly competitive, leadership

was erratic. As the experiment progressed, Justin led less and less in the competitive situation, probably because the follower had more control over who obtained the reinforcement.

Cohen's work demonstrates the sensitivity and control that the methods of behavior analysis bring to the study of the social behavior of individuals. In all cases, reinforcement had a profound effect on social behavior. In addition, the study shows that the definitions of cooperation, competition, and leadership made in terms of reinforcement and response do relate closely to these terms as they are used by the general public.

There is now a foundation for a scientific understanding of the factors that control cooperation, competition, and leadership, and that understanding can be related to the world outside the laboratory. Other studies (Hingtgen, Sanders, and DeMyer, 1965; Hingtgen and Trost, 1964) have used reinforcement to produce cooperation behavior in a clinical situation. Hopefully the excellent tradition provided by such research will be continued until a thorough and useful understanding of these behaviors is achieved.

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Two "synthetic social relations"

B. F. Skinner

About 10 years ago, two demonstration experiments were designed for a General Education course in Human Behavior at Harvard. They were briefly described in an illustrated weekly and are occasionally referred to in the psychological literature. It seems advisable to publish a somewhat more explicit account.

THE "PING-PONG" PLAYING PIGEONS

There were several versions of this apparatus, in one of which a motor-driven device returned the ping-pong ball to the playing surface so that the apparatus ran without attention. In a less mechanized version, the "ping-pong" table was approximately 8 in. wide, 16 in. long, and 8 in. high (Fig. 1-1). A pigeon standing at one end could conveniently peck a ball as it arrived at the edge of the table. If the ball rolled off the edge, it fell into a trough and tripped a switch which operated a food dispenser under the opposite edge and thus reinforced the pigeon which "won the point." Light metal rails prevented the ball from falling off the sides of the table. The surface was slightly canted, sloping from a center line toward each edge so that the ball would not stop on it. Wire barriers prevented the pigeons from jumping up on the table but did not interfere with play.

In the finished performance, the demonstrator would start a ball near the middle of the table. It rolled to one edge and the pigeon on that side pecked it, driving it back across the table. At the other edge it was pecked by the other pigeon and thus returned. The pigeons usually watched the course of the ball as it crossed the table, and maneuvered into position to meet the return. They developed considerable skill in sending the ball straight across.

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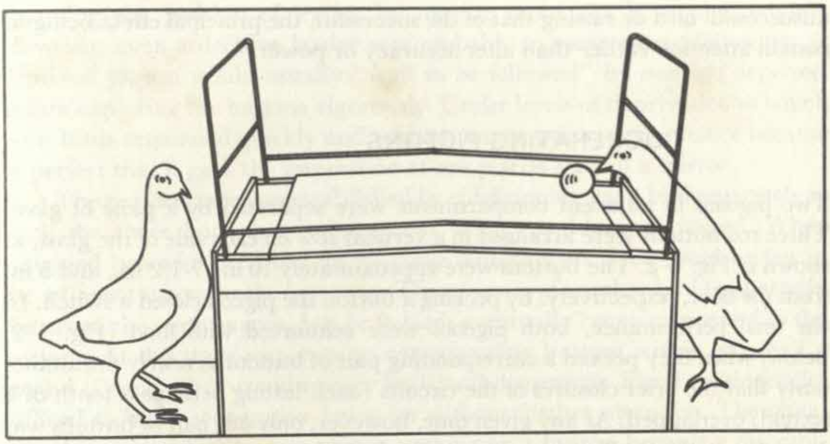

Figure 1-1. Two pigeons "playing ping-pong."

Moving pictures show rallies of as many as five or six shots before a point was made. There is no evidence, however, that either pigeon reached the stage of placing or changing the pace of its shots so that the opponent would miss.

Conditioning was begun with one pigeon at a time. A standard table tennis ball was fastened at the edge of the table, and a hungry pigeon was reinforced with food when it pecked it. At this stage the ball was not a powerful controlling stimulus; when it was moved to a different part of the edge, the pigeons often pecked the air where it had been. Eventually, however, they pecked the ball regardless of its position. The ball was then made free to roll away from the pigeon when struck. A mechanical reinforcing system was set up in which the ball, rolling up a slight grade, struck a cross-bar operating the food dispenser. The distance to the bar was gradually increased. If the ball failed to reach the bar, it rolled back and came to rest against a raised molding along the edge. The molding was later removed.

As the distance between the pigeon and the reinforcing bar was increased, reinforcement was more and more delayed, and the behavior occasionally suffered. Eventually, however, mediating behavior arose to bridge the temporal gap. Even so, in the final game, in which two pigeons participated, the delay between striking the ball and the successful outcome of getting the ball past the opponent was occasionally troublesome. A deteriorating performance could be rescued by reinforcing a pigeon with a hand-switch at the moment it struck the ball. Eventually the behavior was sustained not only for rallies of several shots at a time but for a full "game."

The demonstration offers a convenient example of competition. One bird is reinforced at the expense of another. If one is repeatedly successful, the other suffers extinction ("discouragement"). It was possible to maintain a reasonable balance in successful play by lowering the weight of the relatively

unsuccessful bird or raising that of the successful, the principal effect being to sustain attention rather than alter accuracy or power.

COOPERATING PIGEONS

Two pigeons in adjacent compartments were separated by a pane of glass. Three red buttons were arranged in a vertical row on each side of the glass, as shown in Fig. 1-2. The buttons were approximately 10 in., 7-1/2 in., and 5 in. from the floor, respectively. By pecking a button the pigeon closed a switch. In the final performance, both pigeons were reinforced with food (Fig. 1-2, below) when they pecked a corresponding pair of buttons so nearly simultaneously that the brief closures of the circuits (each lasting perhaps a tenth of a second) overlapped. At any given time, however, only one pair of buttons was operative, and the effective pair was scheduled in a roughly random way.

It was necessary for the pigeons to cooperate in two tasks: (1) discovering the effective pair and (2) pecking both buttons at the same time. In general, no pattern of exploration could be observed. The pigeons tested all three pairs of buttons in what was evidently an unsystematic way. In general, there was a division of labor with respect to the two tasks. One pigeon (the "leader") explored—that is, it struck the three buttons in some order. A similar performance could have been generated in one pigeon alone in the apparatus by requiring simply that a given one of three buttons be struck. The other pigeon (the "follower") struck the button opposite that being struck by the leader. Similar behavior could have been generated in one pigeon alone in the apparatus if one button after another had been marked by a discriminative stimulus.

A well-marked leader-follower relation could be established or reversed by altering the relative level of food deprivation, the more deprived bird

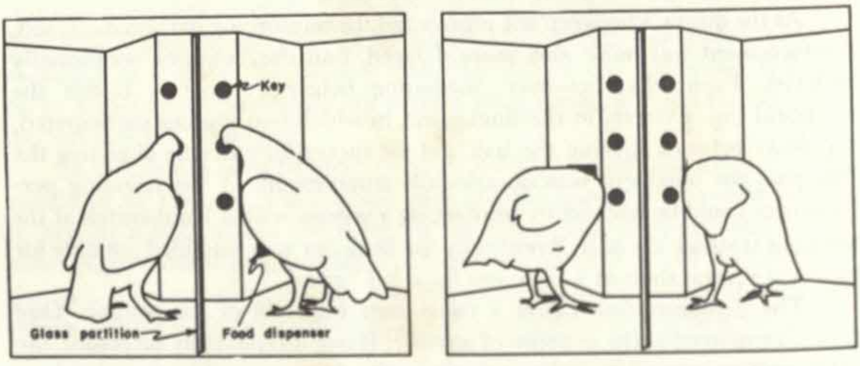

Figure 1-2. *Left:* Two pigeons cooperating by pecking corresponding buttons at the same moment. *Right:* Pigeons eating from food dispensers.

assuming the position of leader by moving more alertly to the buttons. However, even a decisive leader was probably to some extent following. A deprived pigeon would usually "wait to be followed" by one less deprived before exploring the buttons vigorously. Under levels of deprivation at which both birds responded quickly and without interruption, performance became so perfect that it gave the impression of one pigeon seen in a mirror.

The performance was established by conditioning each bird separately to peck the three buttons, reinforcement being roughly randomized. When sustained behavior occurred on all three buttons, two birds could be put in the adjacent spaces for the first time. The presence of another bird temporarily disturbed the performance, but both birds eventually began to respond to the buttons. At this stage responses to corresponding buttons within, say, half a second of each other would trigger both food-dispensers. These contingencies sufficed to build cooperative behavior without further attention. The visual stimulation supplied by one pigeon pecking on a button became a discriminative stimulus controlling a response to the corresponding button on the part of the other.

Prolonged exposure to these conditions made pigeons strongly imitative in other respects. They would often drink from glasses of water in the compartments at the same time, for example. The extent to which their behaviors were mutually controlled was informally demonstrated when the experiment was shown to a group of biologists, one of whom suggested putting the birds in the opposite compartments. The birds immediately lined up alongside the glass plate, facing away from the buttons. They thus assumed their previously effective positions relative to each other, but were now facing the audience through the transparent front wall of the apparatus. Though no buttons were available, they immediately began to cooperate in exploring a corresponding area, bobbing up and down in a perfect mirror-image pattern under the control of each other's behavior. Possibly because the leader-follower relation had frequently been shifted, each bird was evidently largely controlled by the behavior of the other.

The reinforcement of cooperation between children

Nathan H. Azrin
and
Ogden R. Lindsley

Most methods for the development and experimental analysis of cooperation between humans require specific instructions concerning the cooperative relationship between the individual responses. Peters and Murphree have developed one of the most recent of these methods (1). Skinner has suggested (2), and shown with lower organisms (3), that cooperation between individuals can be developed, maintained, and eliminated solely by manipulating the contingency between reinforcing stimuli and the cooperative response.

The advantages of eliminating instructions concerning cooperation are that (*a*) the initial acquisition of cooperation can be studied, (*b*) subjects (*S*s) that learn by demonstration and instruction with difficulty (i.e., infants, certain classes of psychotics, and lower organisms) can be studied, and (*c*) no problems involving the effects of instructions upon the behavior of the *S*s are involved.

Some more general advantages of operant conditioning techniques are (*a*) a more continuous record of the cooperative process is obtained, (*b*) extraneous environmental variables are minimized, and (*c*) relatively long periods of experimental observation are possible.

PROBLEM

Can cooperation between children be developed, maintained, and eliminated solely by the presentation or nonpresentation of a single reinforcing stimulus, available to each member of the cooperative team, following each cooperative response?

Cooperative teams

Twenty children, seven to twelve years of age, were formed into ten cooperative teams of two children. The children in each team were

From *The Journal of Abnormal and Social Psychology*, 1956, **52**, 100–102. Reprinted by permission of American Psychological Association.

matched as to age and sex. Seven teams were boys and three were girls.[1] Selection was made via the request, "Who wants to play a game?" The first two volunteers of the same age and sex were chosen for each team. The age given by the children was verified against available community center records. No information concerning the game was given during the selection. No teams were rejected.

Cooperative response

Cooperation was assured by designing an apparatus that (*a*) could not be operated by one individual alone (assuring group behavior), and (*b*) demanded that one individual respond to the behavior of the other individual in order to produce reinforcement (assuring cooperation).

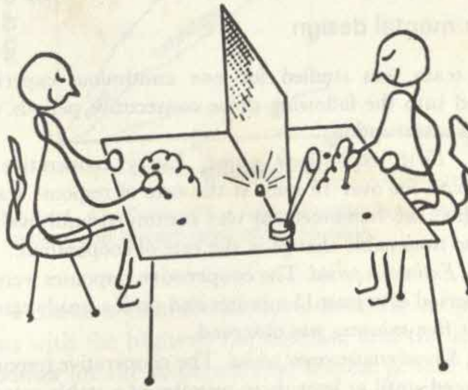

Figure 1-3. Apparatus used for the reinforcement of cooperation between children.

Procedure

The two children of each cooperative team were placed at opposite sides of a table with three holes and a stylus in front of each child (see Fig. 1-3). A wire screen down the center of the table prevented each child from manipulating the other child's stylus, which was on the other side of the table.

The following instructions were given: "This is a game. You can play the game any way you want to or do anything else that you want to do. This is how the game works: Put both sticks (styli) into all three

[1] We wish to thank the Harriet Tubman House and the South Bay Union of Boston, Mass., for providing the subjects and the use of their facilities.

of the holes." (This sentence was repeated until both styli had been placed in the three available holes.) "While you are in this room some of these" (the experimenter (E) held out several jelly beans) "will drop into this cup. You can eat them here if you want to or you can take them home with you." The instructions were then repeated without reply to any questions, after which E said: "I am leaving the room now; you can play any game that you want to while I am gone." Then E left the room until the end of the experimental session.

If the styli were placed in opposite holes within 0.04 seconds of each other (a cooperative response), a red light flashed on the table (conditioned reinforcing stimulus) and a single jelly bean (reinforcing stimulus) fell into the cup that was accessible to both children.[2] Cooperative responses were recorded on counters and a cumulative response recorder in an adjoining room.

Experimental design

Each team was studied for one continuous experimental session divided into the following three consecutive periods without experimental interruption:

1. *First reinforcement period.* Every cooperative response was reinforced for over 15 min. If the rate of response was not steady at this time, the reinforcement was continued until five minutes passed with no noticeable change in the rate of cooperation.

2. *Extinction period.* The cooperative responses were not reinforced for a period of at least 15 minutes and until a steady rate of response for at least five minutes was observed.

3. *Second reinforcement period.* The cooperative responses were again reinforced until at least three minutes of a stable rate occurred. This was done to determine whether a reduction in rate during the extinction period was due to extinction, satiation, or fatigue.

RESULTS

All teams learned to cooperate without specific instructions in the first 10 min. of experimentation. Observation through a one-way vision screen disclosed that leader-follower relationships were developed and maintained in most cases. Almost immediately eight teams divided the candy in some manner. With two teams, one member at first took all the candy until the other member refused to cooperate. When verbal agreement was reached in these two teams, the members then cooperated and divided the candy. Most vocalization

[2] Skinner (3) presented two reinforcing stimuli (one to each pigeon) following each cooperative response.

occurred during the initial acquisition period and throughout the extinction period. This vocalization was correlated with a higher variability in rate during these periods. (See below).

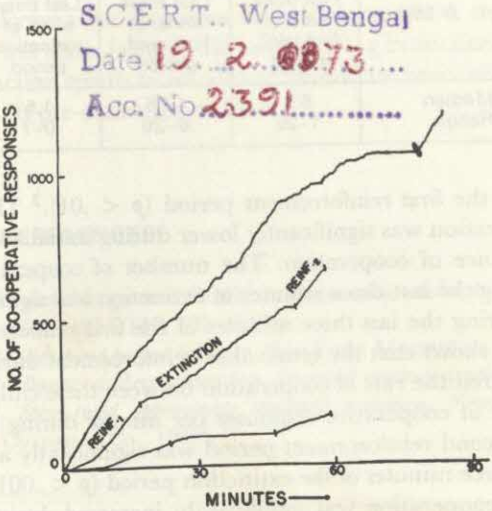

Figure 1–4. Cumulative response records for the teams with the highest, median, and lowest rates of cooperation.

Figure 1–4 contains cumulative records of the cooperative responses of the three teams with the highest, the median, and the lowest number of cooperative responses for the experimental session. These curves show a large difference in the rate of acquisition of cooperation. One team took almost 10 minutes to acquire a high cooperative response rate. Stable rates of cooperation can be observed during the latter parts of the first reinforcement period. The gradual, rather than immediate, decline in cooperation during extinction suggests an orderly extinction of cooperative behavior as is found with individual extinction curves. In all cases the variability of rate was greater during extinction than during reinforcement. Skinner has found this increased variability in rate during extinction with lower organisms and has described it as emotional behavior (2, p. 69). The high rate of response following the first reinforcement of the second reinforcement period shows that reacquisition is almost immediate.

Table 1–1 contains a quantification of the records for statistical analysis. The median and range of the number of cooperative responses per minute for all 10 teams during the critical periods of the experiment are given. The number of cooperative responses per minute for the first three minutes of the first reinforcement period was significantly lower than the rate during the last

Table 1-1. The median and range of the number of cooperative responses per minute for the critical experimental periods

N 10	Number of cooperative responses per minute			
	First three mins. of first reinf. period	Last three mins. of first reinf. period	Last three mins. of extinction period	Last three mins. of second reinf. period
Median	5.5	17.5	1.5	17.5
Range	1–26	6–26	0–7	6–27

three minutes of the first reinforcement period ($p < .01$).[3] This shows that the rate of cooperation was significantly lower during initial acquisition than during maintenance of cooperation. The number of cooperative responses per minute during the last three minutes of extinction was significantly lower than the rate during the last three minutes of the first reinforcement period ($p < .001$). This shows that the removal of reinforcement during extinction significantly lowered the rate of cooperation between these children.

The number of cooperative responses per minute during the last three minutes of the second reinforcement period was significantly above the rate during the last three minutes of the extinction period ($p < .001$). This shows that the rate of cooperation was significantly increased during the second reinforcement period and that the drop in rate during extinction was due to the absence of the reinforcing stimulus rather than satiation or fatigue. The rates of cooperation during the second reinforcement period and the last three minutes of the first reinforcement period were not significantly different and show that the rate was almost immediately restored to its pre-extinction value upon the presentation of reinforcement for the second time. The rate of cooperative responding during the first three minutes of the second reinforcement period was significantly higher than during the first three minutes of the first reinforcement period ($p < .02$). This again shows that the reacquisition of cooperation was not gradual, as was initial acquisition, but occurred almost immediately.

CONCLUSIONS

Operant conditioning techniques can be used to develop, maintain, and eliminate cooperation between children without the use of specific instructions concerning cooperation. The rate of a cooperative response changes in much the same way as a function of single reinforcements as does an individual response. In the reinforcement of cooperative responses, a reinforcing stimulus need not be delivered to each member of the cooperative team following each

[3] Wilcoxon's nonparametric T for paired associates was used in all statistical treatments (4).

cooperative response. The presentation of a single reinforcing stimulus, available to each member of the cooperative team, is sufficient to increase the rate of cooperation. The cooperative response gradually increases in frequency when reinforced and gradually decreases in frequency when no longer reinforced (extinction). Cooperative responses are maintained at a stable rate during reinforcement but occur in sporadic bursts during extinction. Reinforcement following extinction results in an almost immediate restoration of the rate of cooperation to its pre-extinction value.

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Justin and his peers:

An experimental analysis of a child's social world

Donald J. Cohen

The techniques of the experimental analysis of individual behavior developed in the researches of Pavlov, Watson, and Skinner have only recently been extended to human activities involving more than one person (2; 8, ch. 19). The methods of free operant conditioning allow for a sensitive control of particular variables and for analysis of changes in behavior through time.

From *Child Development*, 1962, **33**, 697-717. Copyright by the Society for Research in Child Development, Inc., 1962.

Dr. Ogden R. Lindsley, Director of the Behavior Research Laboratory, has influenced this research and shaped the behavior of the author in more ways than can possibly be enumerated. The interest Dr. Lindsley has shown, the guidance and criticism he has afforded, and the freedom he has allowed go far beyond that which any student has the right to expect.

The research was conducted at the Behavior Research Laboratory, Metropolitan State Hospital, Waltham, Massachusetts. The experiments were supported by a special research grant from Brandeis University and Research Grant NSF G-9516 from the Division of Social Sciences, National Science Foundation.

This experimental approach is thus methodologically suitable for the study of social transactions which are continuous (1, pp. 112–117) and which can be shown to be related to particular classes of environmental events. While interviewing and questionnaire techniques can be used to obtain data on retrospective reports of behavior and attitudes or dispositions, the free operant method can be used in the analysis of ongoing behavior and the changes in behavior which occur when people confront each other in a social situation. Also, while field observation is usually inexact and open to observer bias, the free operant method allows for scientific control and precision in response definition and measurement.

The first free operant experimental analysis of human social behavior (2) demonstrated the possibility of generating cooperative behavior in young children through the scheduling of candy reinforcements. The cooperative behavior could be extinguished by withholding the reinforcements and regenerated through the rescheduling of the reinforcements.

In this present paper, a new instrument for the experimental analysis of social behavior is briefly described. The results of the social behavior of a particular young person are discussed. These results demonstrate that the young man behaves differently towards people with whom he has different nonexperimentally determined relations. Nonexperimental observations of the social behavior of the subjects support the clinical validity of the experimental findings.

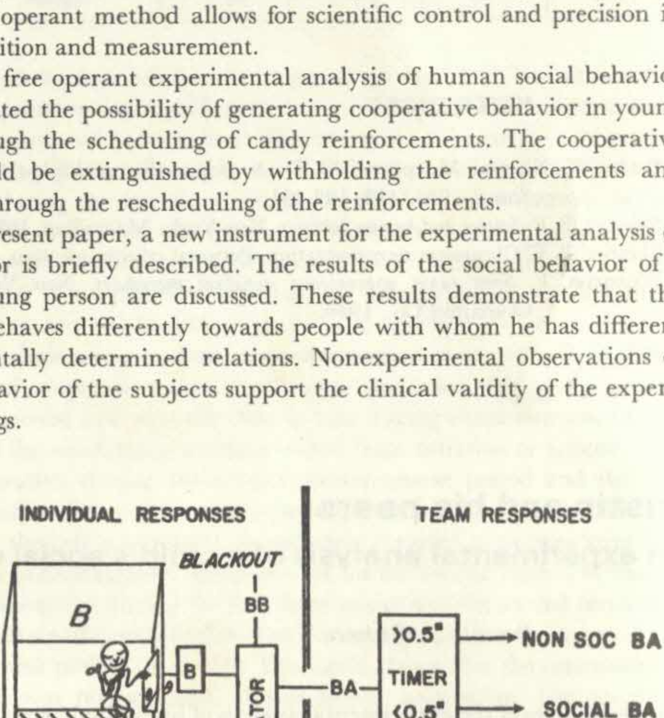

Figure 1–5. Schematic drawing of apparatus and response definition for individual and team responses. Each room is equipped with a metal plunger; movement of the plunger produces an electric impulse which is electrically defined into individual and team responses as shown in the block diagram.

METHOD

Subjects[1]

The social behavior of Justin, a normal 13-year-old, is studied in relation to people with whom he has different relationships. The five people involved in this analysis of Justin's social profile are his brother (age 16), sister (age 14), close friend (age 13), mother, and a stranger (age 14).

Apparatus

The experimental environment employed throughout the experiments was two adjacent 6-ft. square rooms. Each room was equipped with a standard operant conditioning panel on one wall (Fig. 1-5) as described by Lindsley (6). Mounted on each panel was a metal plunger; the plunger could be pulled with little effort and in some experiments has been pulled up to several thousand

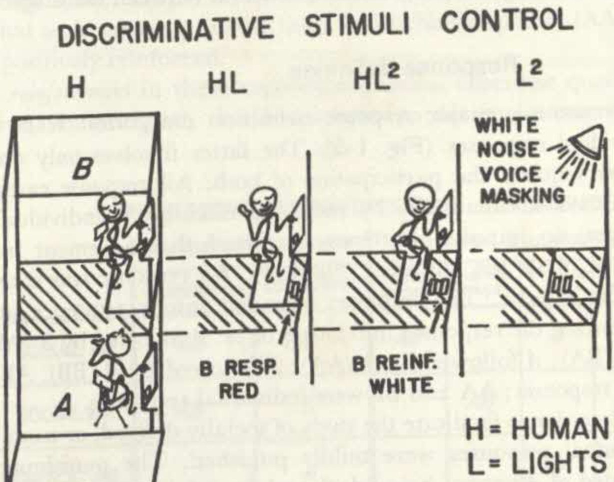

Figure 1-6. Experimental method of controlling the nature of the discriminative stimuli involved in cooperation and competition. With the opaque panel fully open (H), the response and reinforcement of the other subject can be seen through the clear plexiglass window. With the opaque panel fully closed (L^2), a red light mounted on the panel flashes when the other subject responds and a white light mounted on the panel flashes when he is reinforced. There are intermediate conditions (HL and HL^2) between the entirely human (H) and the entirely mechanical (L^2) discriminative stimuli.

[1] The kind cooperation of the Sisters of the St. Joseph's School, Waltham, Massachusetts, the students, and the parents who allowed their children to behave is greatly appreciated.

times within 90 minutes with no signs of fatigue. Located on each panel was a small bin into which the reinforcements (pennies and candy) were dropped. The two adjacent rooms were separated by a clear plexiglass window through which the subjects could see each other when seated in front of the operant panels.

An opaque sliding panel could be closed in several stages to block the plexiglass window (Fig. 1-6). Mounted on each side of the panel were two lights which acted as mechanical stimuli. One light (red) flashed on when the person in the other room pulled his plunger; the other light (white) flashed on when he was reinforced. By successively sliding the panel it was possible to have only human stimuli (H), human stimuli and response light (HL), human stimuli and both lights (HL^2), or the response and reinforcement lights alone (L^2). The experimental consequences of changes in these discriminative stimuli are reported elsewhere (4, 7).

Controlling and recording apparatus was located behind the experimental rooms in an adjoining area from which the experimental rooms were observed through concealed periscopes. A white noise generator delivered covering noise to concealed speakers in each room. The noise was maintained just loud enough to prevent any discussion between the subjects.

Response definition

There are two major response definition categories: team responses and individual responses (Fig. 1-5). The latter involves only one subject, the former requires the participation of both. All response categorization was performed automatically by switching circuits. As individual *A* pulled his plunger, an impulse shortener converted the movement into an electric impulse of .06 sec. duration. Similarly, *B*'s response was converted into an electric impulse. The impulses were fed into a sequence analyzer which categorized the responses into four groups: *A* followed by *B* (AB); *B* followed by *A* (BA); *A* followed by *A* (AA); *B* followed by *B* (BB). AB and BA were team responses; AA and BB were individual responses.

In order to facilitate the study of socially defined, or team, behavior, the individual responses were mildly punished. The punishment for an AA consisted of *A*'s room being darkened for 2.5 sec. during which a pure tone (500 cycles) was sounded through his speaker (*see* [5, p. 35]). When either *A* or *B* was being blacked out, no responses entered the sequence analyzer.

The team responses are further defined on the basis of the temporal relationship between the two responses. An *A* response followed within .5 sec. by a *B* response is a *Social AB*. An *A* response followed within any period of time greater than .5 sec. is a *Nonsocial AB*. *Social BA* and *Nonsocial BA* responses are defined analogously. The value of .5 sec. was chosen on the basis of exploratory investigation. The probability that a second response would follow the first within .5 sec. by chance alone (and without the production of

AA or BB responses) was found to be slight. Team and individual responses of each category were simultaneously recorded on separate cumulative recorders and digital counters. The cumulative records provide a continuous measure of the ongoing social behavior throughout an experimental session.

Reinforcement contingencies

Cooperation is operationally defined in this study as behavior in which both subjects are involved and in which both are reinforced. Competition is defined as behavior in which both subjects are involved and only one is reinforced. That is, cooperation and competition are team responses which are differentiated on the basis of the reinforcement, or "pay-off," contingency. The horizontal rows of Figure 1-7 list the four team responses that are differentially reinforced; the columns are the type of social behavior that is defined by the programmed reinforcement contingency. The italicized letters in the squares specify who is reinforced for each particular team response. Double entries (*AB*) indicate that both subjects are reinforced for that team response (cooperation). Single entries (*A* or *B*) indicate that only one subject is reinforced (competition). Empty squares indicate that no reinforcement is delivered for that team response (extinction). Individual responses (AA and BB) are never positively reinforced.

The term *reinforcement* in these experiments, unless otherwise qualified, refers to positive reinforcement, that is, an event in the environment that

TEAM RESPONSE REINFORCEMENT CONTINGENCIES

	UNCONTROLLED LEADERSHIP		CONTROLLED LEADERSHIP			
	COOPERATION	COMPETITION	A LEADS COOP.	B LEADS COOP.	A LEADS COMP.	B LEADS COMP.
SOCIAL AB	*AB*	*B*	*AB*		*B*	
SOCIAL BA	*AB*	*A*		*AB*		*A*
NON-SOC AB		*A*			*A*	
NON-SOC BA		*B*				*B*

INDIVIDUALS REINFORCED

Figure 1-7. Table of reinforcement contingencies used to differentially reinforce team responses. Double italicized entry (*AB*) indicates that both subjects are reinforced for a team response. Single italicized entry (*A* or *B*) indicates which single subject is reinforced for a team response. An empty square indicates that the team response is programmed for extinction. Contingencies used for programming six different types of social behavior are shown in the table.

increases the frequency of emission of a particular response. The schedule of reinforcement was continuous (crf): for every reinforced team response a penny or piece of candy dropped into either one or both reinforcement bins on the operant panels (*see* [3]). Punishment was also on a continuous (crf) schedule: for every punished individual response (AA or BB) the punished subject (*A* or *B*) was blacked out as described above.

Reinforcement consisted of a mixture of pennies and candy in an approximate ratio of four pennies to one candy (an assortment of gumdrops, pieces of chocolate, and other small candies).

Experimental situation

The two subjects were brought to the laboratory together by the experimenter. They were given a minimal amount of information concerning what was to take place, with instructions limited to the following: "You are going to play a game. You can keep all you get." The subjects were then placed in the adjoining rooms in which the lights were dimmed. No other information was given the subjects at any time during the experimental session. All changes in behavior thus were generated by specific, controlled changes in the experimental conditions or resulted from the "dynamic" aspects of social interaction.

To clarify the experimental procedure, the first few moments of a *characteristic* experimental session will be outlined. The subjects were placed in the adjacent rooms; they sat down in front of the panels. The room lights went from dim to bright, and the window between the two rooms was opened to the position where each subject could see the other as well as the two mechanical stimuli (HL^2 on Fig. 1-6). The subjects waited a minute or two and then explored the operant conditioning panels. They pulled the metal plungers. The initial reinforcement contingency was uncontrolled leadership during cooperation; that is, regardless of which subject led, so long as the other pulled his plunger within .5 sec., both were reinforced. *A* pulled his plunger; *B* pulled his within .5 sec. This constitutes a Social AB response. The room lights dimmed and a light went on in the reinforcement bin on each panel (conditioned reinforcer). A penny (reinforcement) fell into the reinforcement bin in each room and the lights remained dim for 5 sec. (the conditioned reinforcement cycle). The room lights brightened. *B* pulled his plunger and *A* followed within .5 sec. This is a Social BA. The rooms were dimmed and a reinforcement delivered to each bin. When the lights brightened again, *B* pulled his plunger twice in a row (BB). A sequence of two responses by the same subject (individual responding) was mildly punished. *B*'s room darkened while a pure tone was delivered to his speaker for 2.5 sec. (black out B). When the lights went on again, either *A* or *B* could have led, and, so long as the other followed within .5 sec., both were reinforced by a penny dropping into both bins.

EXPERIMENTAL RESULTS

Justin and his brother

Justin is the third born of seven children of an upper-middle class, professional family. There are four male siblings, aged 16, 13, 11, and 6, and three female siblings, aged 14, 12, and 11. Justin is 13 years old, 6 ft., 2 in. tall, and is considered by both his family and teachers as "a most intelligent student." He has grown quite rapidly and, because of his imposing size and intellectual precocity, is thought of by his teachers and schoolmates as a "very unusual and special youngster" who is a "natural-born leader." Despite his size, adults with whom he has had dealings say of Justin that he is a mild-mannered, "gentle youngster," not prone to argumentation or fighting. He is aware of the physical and intellectual impression he makes on people.

The first born child of Justin's family is 16 years old and a high school junior. Justin's brother had had considerable behavioral difficulty; and for a period of almost two years he was treated as an outpatient in a psychiatric clinic. His school record until this year was diametrically opposite of Justin's —he was literally at the bottom of his class. At the beginning of his junior year Justin's brother made considerable effort to overcome his low grades and within several months rose to practically first position in all subjects. Justin's brother is as tall as Justin, but he is withdrawn, has difficulty with any type of social situation, in general is unsure of himself, and, according to his parents, has lived a life overshadowed by his precocious younger brother. The mother's comments on the relationship between Justin and his brother are of the following nature: "They are friendly, but in a competitive way"; "not very likely to cooperate"; "Justin's older brother is easily annoyed."

Experimental session

Figure 1-8 is a compilation of the cumulative records simultaneously produced during the experimental session with Justin and his brother. Justin's brother (*A*) was at the laboratory for the first time and Justin (*B*) for the sixth time. "Disc. Stim." refers to the position of the sliding panel (Fig. 1-6). Throughout this session the panel was not moved: the brothers could see each other and also see a red light flash when the other pulled his plunger. The italicized letters above the curves indicate the individuals reinforced for each correct team response. (*AB*, for example, means that both were reinforced for every "correct" team response). Blackouts (given for AA and BB) were recorded on noncumulative records. Each vertical mark on the blackout lines indicates one 2.5-sec. blackout for either *A* or *B*. Vertical slashes (pips) on the cumulative record curve indicate that a reinforcement was delivered. Since the schedule was crf, reinforcements often were delivered quite frequently; the

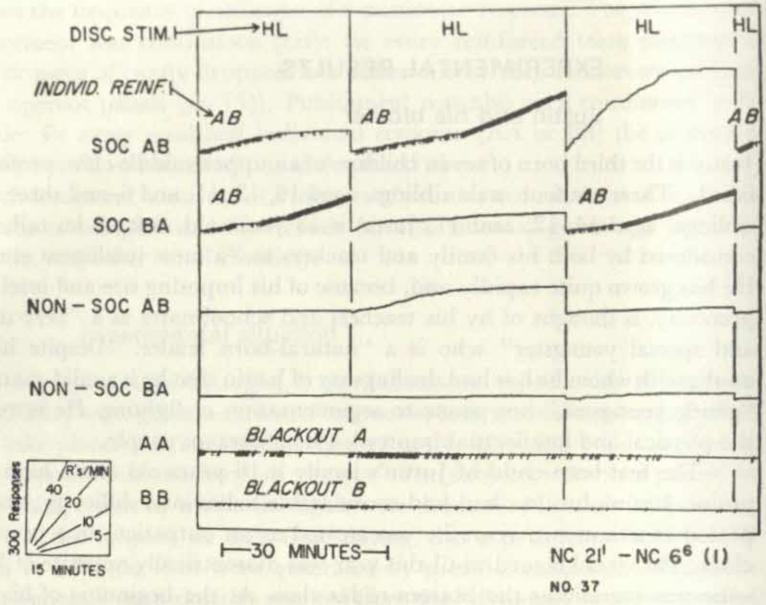

Figure 1–8. Cumulative records of a continuous experimental session with Justin (*B*) and his brother (*A*). There are six simultaneous records, four cumulative records of team responses and two noncumulative records of individual responses (AA and BB). Figures 1–9 through 1–12 are similar records of Justin in interaction with people with whom he has different extraexperimental relationships.

dark black sections on the cumulative record curves result from a close bunching of the reinforcement marking pips.

Segment 1. The session began with a reinforcement contingency of uncontrolled leadership during cooperation. Regardless of which brother led, so long as the other followed within .5 sec. both were reinforced (Fig. 1–8). For the first 11 min. of the first segment Justin's brother (*A*) led significantly more often than he followed. This can be seen by comparing the curve for Soc AB (brother leads) with that of Soc BA (Justin leads). There was a dramatic change, however, after 16 min. when Justin very strongly took the leadership. The strength of Justin's leadership can be seen from the fact that the brother's leadership curve flattens out with only occasional pips representing the reinforced team responses in which the brother led, while there is a fairly even and rapid curve for Justin's leadership (Soc BA). Justin's assumption of the position of leadership after the period of leadership-instability represents a dynamic change in the social behavior of the team. That is, no experimental conditions were changed that can account for this emergence of Justin as the leader in this situation.

The AA responses resulting in blackouts for Justin's brother were bunched at several points during this first segment of the session. They were the asocial or individual responses and occurred only during the time that the leadership was unstable or changing. With the emergence of Justin as the leader and the resulting stability of leadership, the AA responses dropped out and the number of team responses increased.

Segment 2. This segment of the session was controlled leadership during cooperation. No signals or other indications were given to the subjects between segments; for them the entire experimental session was continuous. A new segment of the experiment is considered to begin every time the conditions were changed, and the conditions were changed when the social behavior of the subjects reached some stable or steady state. In the second segment, only those team responses in which the brother (*A*) led and Justin (*B*) followed were reinforced (Soc AB). No reinforcements were presented for Justin's leadership (Soc BA). After 4 min. Justin no longer attempted to lead, as can be seen from a leveling of the Soc BA curve. However, there was not an immediate increase in the number of brother-leading team responses. Instead, for about 20 min. the brother frequently blacked himself out with individual (AA) responses. In the middle of the segment a sudden increase in the number of Soc AB can be observed. At this point the brother assumed the leadership position and both subjects received a high number of reinforcements. During the time that the brother was blacking himself out neither subject received many reinforcements. The first part of this segment contains a high number of Nonsocial AB responses. These frequent Nonsocial AB responses represent Justin's hesitancy at following his brother.

Segment 3. The reinforcement contingency was again controlled leadership during cooperation, but here only those team responses in which Justin was the leader were reinforced. After having led Justin in segment 2, it is clear that Justin's brother was not ready to follow his younger sibling. The Soc AB curve for segment 3 consists of 272 Soc AB responses, for which no reinforcements were delivered. This can be contrasted with the 76 Soc BA (Justin leading) responses of the second segment. Conditions in segments 2 and 3 were identical except that in segment 2 team responses in which brother led were reinforced while in segment 3 team responses in which Justin led were reinforced. The curves for segments 2 or 3 are not, however, symmetrical. In segment 2 Justin gave up the leadership fairly quickly; in segment 3 the brother persisted in attempting to be the leader for 19 min. (producing the sharp AB curve). At the end of the third segment there was acquisition of the reinforced leadership pattern and the conditions were thus changed.

Segment 4. In this segment (as in the second), the team was reinforced only when the brother led; the contingency was controlled leadership during

cooperation. After a brief (1-min.) acquisition period Justin's brother assumed the leadership. It should be noted that the brother persisted in leading in segment 3 but did not persist in following in segment 4.

The total responses for the session were as follows: 561 Soc AB; 451 Soc BA; 123 Nonsoc AB; 42 Nonsoc BA; 175 AA; 44 BB. *A* responded a total of 1527 times, *B* a total of 1265 times. Both received about 640 reinforcements.

The experimental session can be summarized: Justin initially emerged as the leader of his brother; there was cooperation between the brothers but only after much uncooperative behavior; differential reinforcement for leadership controlled the leadership direction but, again, after a long period of acquisition. The meaning of these experimental results will be clearer when the social behavior of Justin and his brother is contrasted with that of Justin and his friend.

Justin and his friend

Justin and his friend are the same age and in the same grade in school. They are friendly at school, play together after school, and serve together at church. The boys consider each other as "best friends" and were quite happy to come to the laboratory as a team.

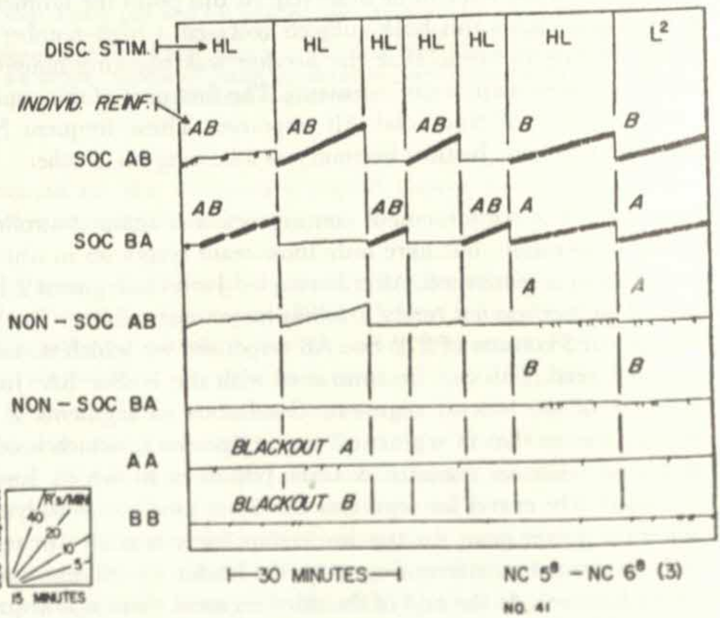

Figure 1-9. Justin (*B*) led his friend (*A*) when the reinforcement contingency was uncontrolled leadership during cooperation. When competition was programmed, Justin and his friend did not compete but, instead, engaged in a complex form of cooperation in which the leadership was alternated.

Figure 1-9 is a record of the third experimental session in which Justin and his friend served as a team. This was the eighth time at the laboratory for both of the subjects. Each subject had thus been in the experimental situation about 10 hr. before this session, 2.6 hr. of which were spent together.

Segment 1. Uncontrolled leadership during cooperation. During segment 1 Justin (*B*) led in 112 of the team responses (Soc BA) and the friend (*A*) led in 39 team responses (Soc AB). The distribution of the team responses in which the friend led is interesting to note. Justin would lead for an extended run of team responses (Soc BA); then the friend would lead for several team responses (Soc AB). The friend's several attempts at leadership were cut short by Justin. The friend's attempts at leadership, quickly met by Justin's self-assertion, represents the dynamic aspect of their confrontation in the experimental situation.

Segment 2. Controlled leadership with the friend (*A*) leading during cooperation. The differential control of leadership was quite rapid; immediately following the extinction of Soc BA (Justin leading), the friend assumed the leadership and maintained the leadership throughout the segment. The rapid increase in the number of Nonsoc AB responses during this segment, a total of 78, is indicative of Justin's unwillingness to respond after his friend responded. Justin showed this same tendency in the experimental session with his brother. His hesitancy to respond is apparent in both cases although Justin did not attempt to lead when not being reinforced for leading.

Therefore, there are two major social behavioral expressions of "unwillingness" to follow: (a) the continued leadership of the subject while this leadership is being extinguished (Justin's brother [*A*], Fig. 1-8, segment 3); (b) the hesitancy to follow as expressed in increased nonsocial responses (Justin [*B*], Fig. 1-8, segment 2; Justin [*B*], Fig. 1-9, segment 2).

Segments 3, 4, and 5. These three segments exhibit the controlled and rapid reversal of leadership during cooperation by arranging differential reinforcement. Reversal of leadership was almost instantaneous with Justin leading in segments 3 and 5 and the friend leading in segment 4.

Segment 6. After cooperative responding was fully acquired and leadership experimentally reversed, competition between the two friends was programmed. What emerged, however, was a complicated form of cooperation in which leadership was alternated between the friends. The alternation of leadership allowed for an even distribution of reinforcements between the subjects with each receiving only 50 per cent of the number of reinforcements that could have been received on a cooperative schedule. The sequence of responses that permitted the subjects to convert a programmed competitive schedule to a complex form of cooperation was of this order: *A* responded and

then *B* responded within .5 sec.; *B* was reinforced for this Soc AB. Then *B* responded and *A* followed within .5 sec.; *A* was reinforced for this Soc BA. The nonsocial responses (Nonsoc AB and Nonsoc BA) were considered as "mistakes" by the two subjects and were "made-up" to provide an even distribution of reinforcements.

Segment 7. The social panel was closed to determine the contribution of the visual presence of the friend to the cooperative alternation of leadership in place of the programmed competition. In segment 7, the subjects could not see each other but could see the two mechanical lights (L^2 in Fig. 1-6). In this particular experimental session, the alternation of leadership between the friends was maintained without their visual presence.

Justin and the stranger

The stranger used in this experiment is the brother of Justin's friend. Justin did not know the stranger before they met at the laboratory, although he knew that his friend has a brother. The stranger is the same height as Justin's friend, is in the same grade in school, and physically resembles him so closely as to be mistaken as his twin. Thus, the stranger did not present any different constellation of physical stimuli to Justin. The only difference between the stranger and the friend to Justin was, of course, their previous social relationships. Both the stranger and Justin's friend are lively young men, active in athletics; both are considered socially "well adjusted" by teachers, although Justin's friend is considered more clever and more "able" than the stranger.

Segment 1 (Fig. 1-10). Justin and the stranger could see each other and also the two mechanical stimuli (L^2). The reinforcement contingency was competition. This was Justin's (*A*) ninth session at the laboratory, the stranger's (*B*) fourth, and this was the first time that they were together as a team. Initially the competitive schedule produced competition of an asymmetric type. Justin (*A*) received reinforcements by quickly responding after the stranger (*B*) responded; for Soc BA, *A* is reinforced. The stranger however, received his reinforcements by distracting Justin. By shouting or waving at Justin, the stranger generated a number (44) of Nonsoc BA responses, for which he (*B*) was reinforced. In distracting Justin, the stranger was relying upon Justin's slowness of movement or the possibility of "catching him offguard" or "asleep."

In segment 1 the stranger led 146 times to Justin's leadership of 59 times. During competition a subject could receive reinforcements by (a) "being on the ball" and pulling his plunger within .5 sec. after the other subject had pulled his; or by (b) somehow "sneaking in" a response in such a manner that the other subject did not pull his plunger until a period of time greater than .5 sec. had passed. Justin used method *a* only. The stranger used both methods *a* and *b*.

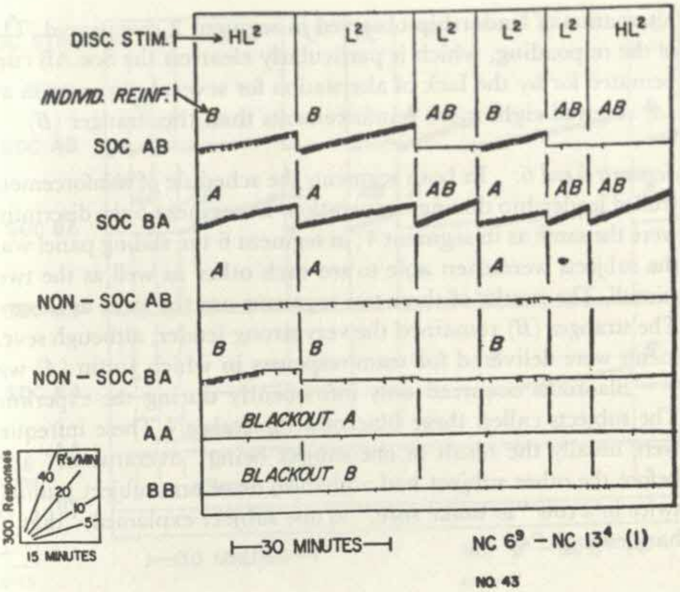

Figure 1–10. Competition between Justin (*A*) and a stranger (*B*) was unstable and was transformed into cooperation by alternation of leadership.

By the end of segment 1 the initial competition was transformed into the complex form of cooperation by alternating leadership as described above. There were few Nonsoc BA and a fairly even alternation of leadership giving each subject an equal share of the reinforcements.

Segment 2. To determine whether the removal of the human stimuli would have any effect on the behavior, the sliding panel was closed. For the first 2 min. following the closing of the panel, the stranger (*B*) again took stronger leadership, as can be seen by the level curve of Soc AB and the density of pips on the Soc BA curve. *B*'s leadership, however, meant that he did not receive reinforcements; during competition, *A* (Justin) is reinforced for Soc BA. Competition which was temporarily restored by removing the human visual stimuli was soon transformed into cooperation by alternating leadership.

Segment 3. With the social panel kept closed (L^2), the contingency was changed to uncontrolled leadership during cooperation. Here the strength of the stranger's (*B*) leadership was clear. Throughout the segment the stranger led Justin, although they would have been similarly reinforced if Justin had taken the leadership.

Segment 4. The discriminative stimuli were held constant (L^2) and the contingency changed to competition. After slight instability, the pattern of

alternation of leadership observed in segment 2 reappeared. The unevenness of the responding, which is particularly clear on the Soc AB curve, was compensated for by the lack of alternation for several responses in a series. Justin (*A*) received eight more reinforcements than the stranger (*B*).

Segments 5 and 6. In both segments the schedule of reinforcement was uncontrolled leadership during cooperation. In segment 5 the discriminative stimuli were the same as in segment 4; in segment 6 the sliding panel was opened and the subjects were then able to see each other as well as the two mechanical stimuli. The results of these two segments are the same as those of segment 3. The stranger (*B*) remained the very strong leader, although several reinforcements were delivered for team responses in which Justin (*A*) was the leader.

Blackouts occurred only infrequently during the experimental session. The subjects called these blackouts "mistakes." These infrequent blackouts were usually the result of one subject being "overanxious" and responding before the other subject had a chance, or of one subject pulling the plunger twice in a row "to make sure," as one subject explained, "that he had pulled hard enough."

Justin and his sister

Justin's sister is a 14-year-old, first year high school student. She was characterized by her mother as being "aggressive, maternal, and not too dependable." Justin's sister attempts to "mother" him, which he reported he does not very much care for. She calls him "brains," "genius," and "egotist." In his informal questionaire Justin said of his sister: she "reminded me of a happy, queer, large, plump, usual girl." Sister realizes that she cannot achieve Justin's rank in school or his intellectual reputation and teases him for being so smart. He in turn teases her for being "a chubby, typical girl."

The experimental session consisted of three different reinforcement contingencies each used in conjunction with three different discriminative stimuli arrangements. This was the fourth laboratory session for Justin's sister (*A*) and the tenth for Justin (*B*). They had been together as a team three times before.

Segments 1, 2, and 3. From the first moments of the experimental session Justin's sister took the leadership. During the changes in discriminative stimuli from HL to L^2 to H (*see* Fig. 1-11), there was no significant change in the leadership or team responses in which Justin led.

Segments 4, 5, and 6. The contingency for these segments was controlled leadership during cooperation with Justin (*B*) as leader. Only Soc BA team responses were reinforced. The Soc AB (sister leads) curves during these three segments are characterized by the occurrence of slight bumps in the curve

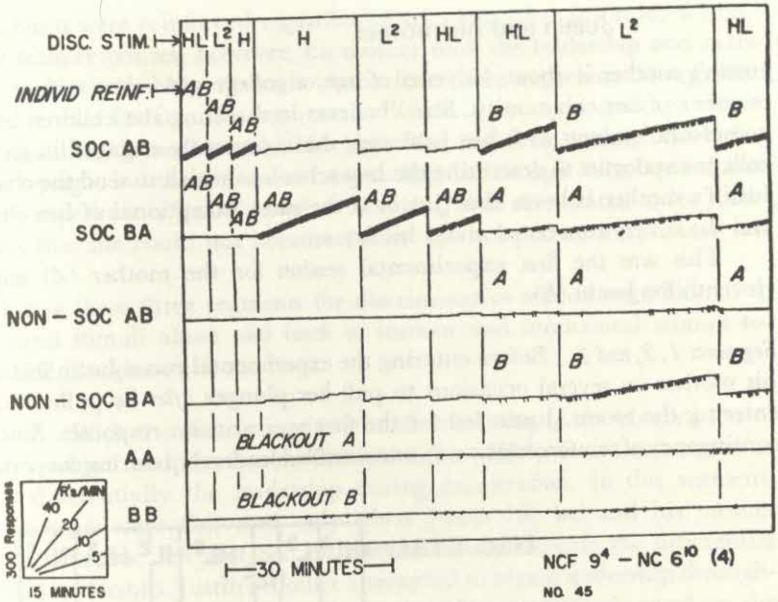

Figure 1–11. Justin's sister (*A*) led Justin (*B*) when the reinforcement contingency was uncontrolled leadership during cooperation. They competed when the reinforcement contingency was competition.

representing the bursts of several responses in which Justin's sister (*A*) led. These bursts were particularly frequent in segment 6, as can be seen on the Soc BA curve. The bursts of team responding where Justin's sister led indicate the sister's attempts to regain the leadership and demonstrate the sensitivity of the method to subtle, dynamic properties of unstable leadership.

Segment 7. The discriminative stimuli in this segment were the sight of the other subject and the one red light that flashed when the other person pulled his plunger. The contingency was competition. In this segment Justin (*B*) received 97 reinforcements to his sister's (*A*) 26.

Segments 8 and 9. The change from human (HL) to mechanical (L^2) discriminative stimuli did not alter the competition between Justin and his sister. In segment 8, however, there was a sharp increase in the number of Nonsoc BA for which Justin (*B*) was reinforced. Justin made distracting noises in his room during this segment. When the social panel was re-opened (HL), a reduction in the nonsocial responses followed but the competition remained. Thus, unlike the teams of Justin and his friend and Justin and the stranger, the competitive contingency did not produce cooperative alternation of leadership between Justin and his sister but, instead, the programmed contingency produced competition.

Justin and his mother

Justin's mother is about 40 years of age, a college graduate, and an active member of her community. She "believes in directing the children in their homework"; along with her husband, she is presently engaged in studying college catalogues to determine the best schools to which to send the children. Justin's mother believes that Justin is the most exceptional of her children and she is very concerned about his future.

This was the first experimental session for the mother (A) and the eleventh for Justin (B).

Segments 1, 2, and 3. Before entering the experimental room Justin instructed his mother on several occasions to pull her plunger *after* he pulled his. On entering the rooms. Justin led for the first several team responses. Since the contingency of reinforcement was uncontrolled leadership during cooperation,

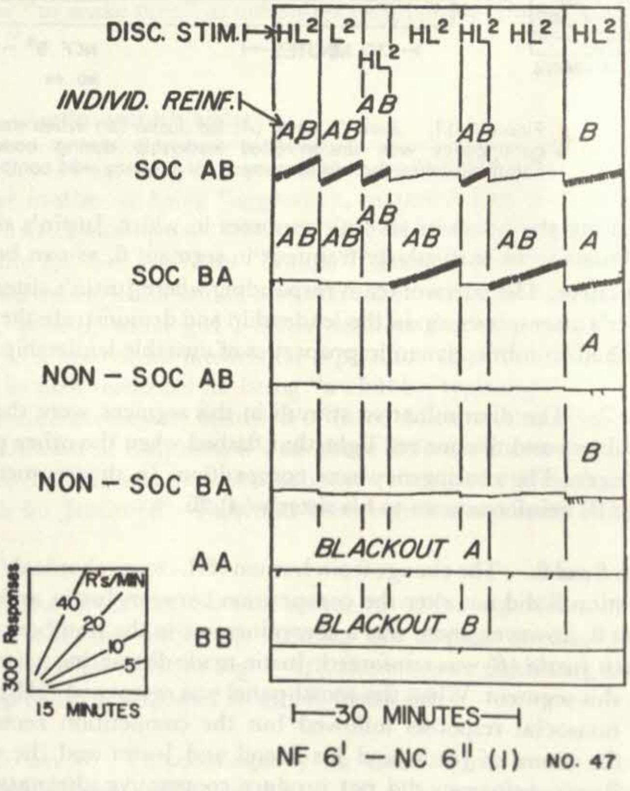

Figure 1-12. Justin's mother (A) took the leadership away from Justin (B) during the first few moments of the experimental session and resisted his leadership throughout the experimental session.

both subjects were reinforced regardless of who led. After Justin led for only several team responses, however, his mother took the leadership and maintained strong leadership throughout the first three experimental segments (*see* Fig. 1-12). During the segments in which they could see each other, Justin signalled his mother to let him lead. She, however, signalled back that she was trying to but that he was not responding fast enough. When questioned after the experiment, Justin's mother remarked that she wanted to let Justin lead but that she could not because Justin was not pulling his plunger fast enough.

During these three segments the discriminative stimuli were altered to mechanical stimuli alone and back to human and mechanical stimuli together (HL^2) with no effect.

Segment 4. With the discriminative stimuli consisting of the observation of the other subject and the two mechanical lights (HL^2), it was attempted to control differentially the leadership during cooperation. In this segment, reinforcements were delivered only when Justin (*B*) led and his mother followed. The Soc AB and Soc BA curves clearly indicate the differential control of leadership. Justin's mother attempted to regain leadership throughout the segment, as indicated by the bursts of responding observed on the curve for Soc AB. These bursts are similar to those occurring in the experimental sessions with Justin and his sister.

Segment 5. Controlled leadership during cooperation with reinforcement for Justin's mother (*A*) leading and Justin (*B*) following. There was very rapid acquisition of the reinforced leadership during this segment. The Soc BA curve does not indicate any bursts of Justin leadership during the segment as observed during segment 4 for his mother.

Segment 6. The contingency here was the same as in segment 4 and the results are similar. There was a significant change in the leadership direction through differential reinforcement in which only those team responses in which Justin (*B*) led were reinforced. The bursts of mother's (*A*) leadership indicate that she is in fact not as good a follower of Justin as Justin is a follower of her, regardless of her statements to the contrary.

Segment 7. The programmed contingency of competition was converted into alternation of leadership. This alternation adds greater strength to the "validity" of the competition recorded for the team of Justin and his sister.

Questionnaire results: brief survey

Each subject was asked to answer an informal questionnaire composed of sentences to be completed and several direct questions. The quotations in this

paper attributed to the subjects are drawn mainly from the answers given to this questionnaire. None of the subjects complained of the length of time spent in the experimental rooms, which sometimes reached over 90 min. The experimental situation was generally conceived of as a problem solving game in which one had to find, in their frequently used term, the "correct combinations" (reinforced contingencies) and to "figure out the lights." The experiment was labelled by one subject: "Unusual, interesting, a little dull, and profitable." Another, on being asked for the first five words that came to mind concerning the session, wrote: "How nice it all was."

In the questionnaire Justin completed the sentence beginning "When I am asked to be the leader" with the statement "I jump to the command. My name is Justin and that means leader."

SUMMARY AND DISCUSSION

The average reinforcement received by each subject for each experimental session was over $6.25. Most of the candy was eaten in the rooms. All the subjects in these experiments have asked if they could return to the laboratory. Sensitive behavioral analysis requires such highly motivated behavior.

A summary of Justin's experimentally determined social profile is presented in Table 1-2. A synopsis of the social behavior of the five teams in four

Table 1-2. Justin's social profile

Team Justin and...	Uncontrolled Leadership	Controlled Leadership: Justin leads	Controlled Leadership: Other leads	Uncontrolled Competition
Brother	Justin leads. Long acquisition. Individual responses.	Long acquisition. Brother persists in leading.	Shorter acquisition. Justin slow to follow.	
Friend	Justin leads; halts friend's attempts to lead.	Rapid acquisition.	Rapid acquisition. Justin slow to follow.	Alternation of leadership.
Stranger	Stranger leads strongly.			Unstable competition becomes alternation of leadership.
Sister	Sister leads strongly.	Rapid acquisition. Bursts of sister responding.		Competition.
Mother	Mother leads strongly.	Rapid acquisition. Bursts of mother responding.	Rapid acquisition.	Alternation of leadership.

Note—No entry—condition not used.

different reinforcement contingencies (*see* Fig. 1-7) demonstrates the differences in Justin's social behavior in each team.

Justin led those people with whom he had previous nonexperimental experience of leadership, his brother and his friend. His sister who "mothers" him and his mother look strikingly similar during cooperation: both were strong leaders during uncontrolled leadership and both exhibited resistance to following him by bursts of inappropriate leadership responding when they were not reinforced for leading. With Justin and the friend, the stranger, and his mother, the competitive contingency was converted into complex cooperation. Justin and his sister displayed strong competition.

Justin has occupied more of his parents' attention than any of the other six children in the family, and the results of this family situation are reflected in the experimental analysis. Both his older brother and his immediately younger sister (age 12, not used in this experiment) have had psychiatric treatment for behavioral problems. The 12-year-old sister suffered from trichotillomania but is now recovered; his older brother still shows signs of his behavioral disturbance. Justin's older sister (age 14) manifests her envy and aggression by "mothering" him; his older brother manifests his by trying to underrate Justin's accomplishments and by trying to prevent further achievement. These Justin-sister and Justin-brother interactions are evidenced in the experimental analysis by the slow development of cooperation and control of leadership (Justin-brother) and the strong leadership accompanied by true competition (Justin-sister). The experimental analysis is validated by such statements as Justin's mother's in relation to her children: "They are the most competitive, aggressive group you ever met." The experimental analysis has successfully evaluated the type of expression given the "competitive, aggressive" family spirit.

Justin and his friend had a long history of extra-experimental cooperation. Their experimental behavior is fully cooperative with immediate alternation of leadership during programmed competition. Justin and the stranger had no history of extra-experimental cooperation; after initial competition during programmed competition, their experimental behavior changed into the more complex form of cooperation. Justin and his brother had a long history of competition and aggression; their experimental behavior is marked by a large number of nonteam responses, long periods of acquisition, persistence of nonreinforced leading, and the other occurrences noted above.

The results of these experiments clearly demonstrate that Justin's social behavior is differentially controlled by reinforcement. However, the dynamic properties of his social behavior are controlled by his previous extra-experimental relations with his teammates. Different patterns with different teammates prove that the method is sensitive to different social relationships. Further, the results of the experimental analysis are validated by the information gathered from the questionnaires and interviews. The experimental analysis, moreover, indicates that the actual social behavior of an individual

may contradict the statements made by that person concerning the social transaction (e.g., Justin and his mother).

The experimental analysis adds definiteness and precision to the non-experimental information concerning the subject's social interactions. Also, it is possible to further refine the type of behavior engaged in by the subjects as manifestations of such clinically relevant concepts as aggression, competition, unwillingness to follow, etc. For example, an analysis of unwillingness to follow has shown that it is expressed in both (a) leading when not being reinforced for leading and (b) hesitancy to respond after the leader has responded. Both (a) and (b) are manifested in the same experimental social circumstances by different individuals.

SUGGESTED METHODOLOGICAL APPLICATIONS

There are a large number of practical and experimental applications for the experimental procedure used in the study of Justin's social behavior. Five areas of possible application will be briefly noted.

1. *Social psychology.* The experimental method provides an instrument for the analysis of the various forms of social adaptation addressed to answering such questions as "Is an individual a 'good leader' because he is *always* hesitant to follow?" One can evaluate the effects of previous controlled social experience of two subjects on their cooperative and competitive behavior. For instance, is the showing of films concerning racial equality an efficient method of changing the competitive behavior between two children of different races into cooperative behavior? Is the opposite social effect achieved with greater or less exposure, with films of the same type of presentation?

2. *Developmental and child psychology.* The method can be used to determine the growth of the social repertoire of the child and the changes that occur in the child's transactions with various members of the family. The dynamics of family social life can be evaluated after such major events as the birth of another child, a summer spent away from the family, the divorce of parents.

3. *Clinical psychology, diagnosis.* The area of the social deficit or disturbance of a child can be experimentally determined and its severity estimated as an aid to the therapist in planning a particular therapeutic program.

4. *Clinical psychology, evaluation.* The experimental analysis of the social profile of the child at various stages in the therapy of the child can be used as an indicator of the changes in the social behavior brought about through therapy. This would provide one means of determining success in psycho-

therapy; and, thus, it could also be used in comparing the therapeutic results of different types of therapy.

5. *Clinical psychology, praxis.* The most longe-range application of the experimental procedure is the direct use of the fully controlled environment in doing behavior therapy with disturbed children. It is possible that, with very long experimental contact, two socially maladjusted children can be brought into cooperative behavior. This form of therapy would have the advantage of working directly with the behavior of the children and immediately reinforcing them for the socially appropriate behavior. For severely disturbed children, the experimental situation with two human subjects can be preceded by training with the mechanical stimuli (lights). By successive approximation and reconditioning, the mechanical stimuli can be gradually removed as the social panel is opened, revealing the other subject. The end of this process of social conditioning is the use of the human discriminative stimuli alone in the cooperative situation. In these cases of behavior therapy, the disturbed child can be teamed with his therapist, another disturbed child, a normal child, a parent, a sibling, or any other type of subject, depending on the area of difficulty, severity of disturbance, and particular stage of social adjustment that the therapist feels the child can handle.

CONCLUSIONS

The experimental determination of five different dynamic patterns of cooperative and competitive leadership between a young man and five other persons clearly demonstrates the sensitivity of this free operant method to important social variables. The close similarity between the experimentally measured patterns and the extra-experimental relationships as determined by questionnaires and interviews demonstrates that these experimental measures have high validity. The method permits a laboratory analysis of a child's social world.

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2

MUTUAL REINFORCEMENT, ALTRUISM, AND AUTHORITY

The previous chapter showed how various patterns of reinforcement programmed and delivered by a mechanical environment can produce and maintain social behavior; the present chapter deals with social situations in which, within restrictions made by the physical environment, two organisms mutually reinforce each other. An organism, as a mediator of reinforcement, is far more complex than any of the mechanical and electronic reinforcement devices heretofore used to analyze behavior. Yet complexity does not preclude understanding. This section presents one early and two more recent attempts to analyze social relationships which involve mutual reinforcement. Again, attention is focused on the conditions which produce, maintain, and eliminate these relationships.

The first article, published in 1943 by W. J. Daniel, follows up an earlier study in which Daniel produced a successful mutually reinforcing relationship in pairs of rats. In the experimental situation used by Daniel, electric shock in a floor grid surrounding a food crock was turned off when one rat sat on a platform. The food crock then became accessible, but only to a second rat. Each pair learned to alternate sitting and eating. This successful social relationship could be explained by the fact that sitting on the platform became one response in a chain of responses which was terminated when food was ingested. In response chains, each response in a series provides the stimuli that control the next response. The entire chain ends with a reinforcer. Early responses in such behavioral chains are reinforced both by later responses and by the ultimate reinforcer. In the present case, sitting on the platform was followed by various motor responses which ultimately led to going to the food crock and ingesting food. Thus the food could have maintained the behavior of sitting on the platform. Alternatively, the behavior

could be explained by the fact that sitting on the platform, as well as providing food for the other rat, reinforced the sitting rat, since in this way he escaped the shock. The study by Daniel presented in this section, "Higher order cooperative problem solving in rats," was designed to study this second possibility. However, within the framework of this volume, the relationship which resulted could best be described as one of mutual reinforcement.

Daniel added to the food crock a lid which could be opened by one rat sitting on the platform. Then he trained pairs of rats to successfully alternate sitting and eating as described above. Finally he turned off the shock during gradually lengthening periods of time at the beginning and end of each session until the shock was eliminated. Under this final condition, the behavior deteriorated: both rats simply sat by the closed food crock. The behavior persisted even under extreme deprivation, and some of the rats actually starved to death.

Deterioration of the initial relationship of mutual reinforcement coincided with the elimination of shock. A question remains, however: Was it the discontinuation of the punishment for both rats sitting on the grid which allowed the behavior to deteriorate, or was it the change in the stimulus conditions caused by the elimination of the shock and the addition of the lid to the food crock? Some attempt was made to transfer the stimulus conditions by eliminating the shock in steps, yet the addition of the lid to the crock could have been an important change. When the control exerted by the shock was eliminated, the lid on the food crock suddenly became salient, and the rats had not been trained to deal with it. Nevertheless, the opportunity for food-maintained responding did exist. Probably the escape from shock was responsible for the mutually reinforcing behavior of the rats.

In any case, Daniel's work does show that, given the right conditions, successful mutual reinforcement can occur in rats. However, the behavior is highly dependent on the environmental and/or training conditions and seems difficult to transfer to other conditions. Human relationships would probably transfer more easily. In fact, the subjects in Azrin and Lindsley's study of "cooperative competition" rapidly learned to alternate their reinforcements in a manner similar to the successful behavior of Daniel's rats. Mutually reinforcing relationships between human organisms do break down; "sharing" by children must frequently be mediated by a mother; work arrangements based on cooperation or on mutual reinforcement between adults deteriorate. Like cooperation, mutual reinforcement is one of the more desirable social relationships. Skinner is said to have defined love as mutual positive reinforcement. Knowledge of the conditions which produce and destroy mutual reinforcement would have many applications to the improvement of human social relationships.

The second study of mutual reinforcement presented here is by J. J. Boren, and entitled, "An experimental social relation between two monkeys." Boren used an apparatus which consisted of two experimental chambers placed next to each other. The usual stimulus lights and response levers were provided for each; however, in this situation, responses (lever presses) by one monkey produced food for the other. Boren developed a successful mutually reinforcing relationship in two pairs of monkeys, and then demonstrated its breakdown. In the more successful of the two pairs, the relationship was developed under strong stimulus conditions and was tied closely to various training operations. In the second pair, these conditions were not as strong and, perhaps coincidentally, neither was the mutual reinforcement. A requirement that the monkeys alternate in reinforcing one another was also included only for the first pair. After Monkey *A* reinforced Monkey *B*, Monkey *B* had to reinforce Monkey *A* before *A* could again reinforce *B*. When this requirement of alternation was eliminated, the mutual reinforcement broke down. The monkeys would have starved if their diets had not been extra-experimentally supplemented. Boren's excellent analysis of these breakdowns shows how social factors themselves work to control responding.

The method used by Daniel was typical of that era. The gross motor responses required of the subjects involve problems of response definition and are more amenable to simple counting than to producing a detailed record of the progress of the experiment. In addition, Daniel did not have devices commonly used today, such as a shock scrambler and a device for presenting food that would not have necessitated adding a lid to the food crock. Boren's more modern equipment, besides minimizing technical difficulties, produced data in a form which allowed him to make a fine analysis of the social relationships and of their subsequent deterioration.

Studies similar to Boren's have been attempted with human subjects by Sidowski and coworkers (Sidowski, Wyckoff, and Tabory, 1956; Sidowski, 1957; Sidowski and Smith, 1961; Crawford and Sidowski, 1964; Gregovitch and Sidowski, 1966). In Sidowski's experimental arrangement, one subject can deliver either shocks or "scores" to another subject who can reciprocate. Sidowski's results are obscured by averaging, yet the following excerpts suggests the type analysis of the social interaction that could be made, given detailed data:

> Generally, we might assume random behavior by both *S*s at the beginning of the experimental session. For example, let us suppose that each *S* made a response that shocked the other. It is not unlikely that that event might occur by accident early in the session. However, it is clear that some shift away from this behavior would soon appear since neither *S* is receiving reinforcement and both are being punished. . . . The *S*s might shift at the same time, or one might shift sooner than the other, resulting in at

least two possible new patterns. If both shifted to the reinforcement button at the same time, both would now receive reinforcement and we would expect a tendency for this pattern to continue. (In fact, the same prediction would be made if *S*s commenced to reinforce each other at any time). This pattern is perhaps the most obvious "self-sustaining" pattern which might emerge, and thus is one of the possible end states which might prevail. On the other hand, suppose that one *S* pressed the reinforcement button while the other pressed the shock button. The *S* who is pressing the reinforcement button should tend to shift to the shock button, with the result of reversion to the condition of both shocking each other. Since both of these patterns are "unstable", we might obtain a continual oscillation between the two states, with the one *S* and then the other shifting temporarily to the reinforcement button. . . . (Sidowski, Wyckoff, and Tabory, 1956, p. 118).

Sidowski's analysis is apparently fictional. The actual results could be complicated by effects peculiar to aversive stimuli and intermittent reinforcement. Nevertheless, methodologies such as those used by Boren and Sidowski could be extremely useful in studying mutual reinforcement in human beings.

Two types of mutual reinforcement with analogies in ordinary social experience are altruism and authority. The altruistic organism reinforces another with no apparent reinforcement for itself; it appears to respond "just for the good of" the other organism. Since behavior has not been known to occur in the complete absence of reinforcement, true altruism probably does not exist. However, behavior with a functional resemblance to altruism does occur. Probably the reinforcement is of a subtle, postponed, or generalized[1] nature. The behavior known as altruism, or "unselfishness," is usually desirable, and the conditions which produce it are worth investigating.

The behavior of Daniel's rats and Boren's monkeys is altruistic in the sense that the responses of one organism appear to reinforce only the other organism. However, in the absence of certain constraints the behavior breaks down, and the altruistic behavior appears to be closely dependent on reinforcement for the responding organism itself. Boren mentions several studies of altruism in his introduction. In one (Boren and Littman, 1961) a rat would, for a time, press a bar to produce food that another rat would eat. In the complete absence of reinforcement for the bar-pressing rat, the behavior extinguished. It is interesting, however, that in one pair the behavior was maintained by very low rates of reinforcement for the responding rat. Such situations may appear as altruism when the observer sees only the unreinforced responses. In two other studies mentioned by Boren, rats were found to respond to relieve the distress of another rat (Rice and Gainer, 1962), and some monkeys were found to postpone responding for reinforcement in order to avoid shocking another monkey (Masserman, Wechkin, and Terris, 1964).

[1] See Chapter 3 for a discussion of generalized reinforcers.

Such behavior would probably be called altruism, although the distress of the other animal may function as an aversive stimulus from which escape or avoidance is reinforcing.

A study by Paskal and Aronfreed (1965) examined a similar altruistic situation with human subjects. Seven- and eight-year-old girls would increase responses on a bar that was an incorrect choice in a classification task, apparently to stop another child's distress cues. However, a significant increase in such responses occurred only when the child had experienced both of two previous conditions: (1) when an experimenter's distress cues had been paired with the subject herself hearing an aversive noise, and (2) when the noise heard by the subject had previously been stopped by an experimenter making the incorrect choice. When the noise heard by the subject had been paired with absence of distress cues from the experimenter, while the subject had heard no noise when the experimenter did emit distress cues, responding on the incorrect bar did not increase significantly. Also, when the experimenter had previously responded to stop only a nonaversive noise heard by the subject, the subject did not later increase responding to stop another child's distress cues. Thus, altruism, in this case, seemed to require, first, a previous association of aversive stimulation of the responder with the distress cues of another person, and second, that another person should previously have responded to stop aversive stimuli received by the subject. The exact nature of these prerequisites is uncertain; however, again altruistic responses appear possible, but only under certain conditions.

Obviously the distress of another organism is not always an aversive stimulus. In the behavior known as sadism, and perhaps in the behavior currently studied as aggression, the distress of another organism can act as a reinforcer. However, the type of altruism which is reinforced by escape or avoidance of distress to others is another desirable social behavior. Discovery of the conditions which make cessation of the distress of another organism a reinforcer could lead to a world with considerably less suffering.

In the third paper presented in this chapter, "A method for studying altruism in monkeys" by A. D. Colman, K. E. Liebold, and J. J. Boren, altruistic behavior was produced in a monkey. The experimental apparatus was the same used previously by Boren; however, two response levers in each experimental chamber would produce food. On one lever, every thirty-sixth response was reinforced by a food pellet delivered to the chamber of the responding monkey; on the other, every thirty-sixth response was also reinforced, but in addition every first response was followed by food for the monkey in the adjacent chamber. Thus, with no extra effort, both monkeys could provide extra food for each other simply by responding on a certain response lever. Two pairs of monkeys were used in the experiment. In one

pair, both monkeys were apparently unresponsive to the altruistic reinforcement and consistently responded on the nonaltruistic lever. In the other pair, one monkey also consistently preferred the nonaltruistic lever. However, the other member of the pair preferred the lever which also fed the second monkey. Since this preference disappeared when the second monkey was removed from his chamber, reinforcement of the second monkey was apparently crucial to maintaining the preference for the altruistic lever. The relationship studied by Colman, Liebold, and Boren allowed the animals to extract maximum reinforcement from their environment. The genesis of the one instance of altruistic behavior was not clear. However, future work, perhaps along the same lines, may demonstrate the conditions necessary to produce a high rate of such behavior.

Authority is another relationship involving mutual reinforcement. Adams and Romney (1959) have analyzed authority, on a nonexperimental basis, as follows. In authority, one organism first presents a discriminative stimulus. A second organism then responds by reinforcing the first organism. The first organism then reinforces the second's response. Or, more cryptically, *A* presents an S^D which control's *B*'s response. *B* responds, reinforcing *A*. *A* reinforces *B*. For example, a child asks for water. A parent, hearing the request, gives him water. In order for the authority relation to continue, the child must reinforce the parent. The parent may be reinforced by a smile and a "thank you" from the child, or simply by a cessation of the child's distress, or evidences thereof. The child is, of course, more likely to ask for water again under the same motivational and discriminative conditions (that is, when he is thirsty and there is a parent present who will get water for him), thus maintaining the authority relationship.

Authority may be regarded as mutual reinforcement in combination with leadership. The person wielding the authority first responds to provide a discriminative stimulus which makes successful reinforcement by and for the other person possible. As Boren's work shows, such discriminative stimuli can make mutual reinforcement more successful. Indeed, complex chains of individual behavior are executed more effectively when controlled by strong discriminative stimuli. Authority can be a constructive social relationship when it facilitates mutual reinforcement. The type of authority—perhaps best called despotism—with an undesirable connotation is that social behavior in which the wielder's reinforcement of the follower depends on aversive stimuli. "Do this or I'll beat you, starve you, or throw you in jail." Such authority relationships may well be viable, but they are not pleasant for the follower, and can, as Chapter 7 will show, lead to other undesirable situations. Authority relationships help to structure social behavior and make it more effective. Whenever possible, however, they should rest on mutual positive reinforcement.

Mutual reinforcement is one of the most basic and important topics in the study of social behavior. It is also one of the most untouched. A better understanding of the conditions which control mutual reinforcement could increase the occurrence of mutual positive reinforcement, altruism, and constructive authority, as well as decrease indifference to the suffering of others and the use of aversive stimuli to control behavior. Hopefully, this improved understanding will come soon.

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Higher order cooperative problem solving in rats

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INTRODUCTION

In an earlier report (2) the writer described an experiment in which cooperative behavior in pairs of rats was obtained and quantitatively measured.

Briefly, the experimental situation consisted of a grid box $22\frac{1}{2}''$ long × $12''$ wide × $4\frac{1}{2}''$ high, with a grid floor and a glass top. A filled food crock was placed in the center of the floor, flush with the grid and $8''$ from the edge of the platform level with the grid at the end of the cage. A high resistance shocking circuit supplied current to the grid, and this current could be eliminated by a rat's stepping on the platform. The grid was electrified as long as the platform at the end of the cage was not depressed. This experimental set-up demanded that one rat be on the platform if either was to get food. The following results were obtained: (*a*) the rats learned to "take turns" at the food crock and at the platform; (*b*) they learned to decrease the number of shocks by decreasing the number of times they stepped off the platform and electrified the grid. This decrease in shocks was a genuine decrease, i.e., it was not due to the fact that they alternated less for the frequency of the alternations varied independently of shock; (*c*) they obtained sufficient food, and (*d*) they accomplished more and more of their shifts in such a manner as to escape shock. In short, they satisfied both motives in a situation in which the satisfaction of either motive was contingent upon the behavior of both animals.

PROBLEM

In the previous experiment we found 3 of the 4 pairs of animals fulfilling to a considerable extent, the criterion of cooperative behavior set in that situation. However, all pairs of rats were not equally cooperative.

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The problem set in the experiment described here is that of determining how much farther this cooperative behavior can be developed. In the previous problem the rat might be said to be cooperating under duress, i.e., under shock or threat of shock. In this experiment the problem will be to reduce the shock systematically and quantitatively and to measure the changes in cooperative behavior as the shock is reduced and finally eliminated altogether. The purpose of this experiment then is to provide possible answers to the following questions:

1. What is the relation of shocks (duress) to cooperative behavior? What will be the character of the changes in cooperative behavior as we systematically reduce and finally, totally eliminate the shock?

2. How long will the cooperative behavior survive after the total elimination of shock?

3. Will a pair of animals less cooperative during the training trials be affected in the test trials more or sooner than is a more cooperative pair?

SUBJECTS

In this experiment 3 pairs of white rats were used, 90 to 120 days old at the start of the experiment.

APPARATUS

The apparatus used in this experiment is identical with that described in an earlier report excepting in one respect. A cap for the food-crock was so arranged that when no rat was on the platform and the grid was electrified a circuit to a solenoid was activated and the cap was snapped over the food crock in a horizontal plane. Thus in addition to being shocked neither rat could obtain food. The solenoid which moved the food-cap was enclosed in a Stoelting sound proof box making its operation as quiet as possible.

PROCEDURE

The first 53 days of the experiment are identical in procedure to the experiment reported earlier (2). The schedule was as follows:

I. Preliminary training: rats run one at a time

Day 1–8. Two 450″ trials with food crock in place and no shock.

Day 8. 20 trials with grid electrified to train rat to go to the platform and escape shock.

Day 9-13. 20 irregularly mixed food and shock trials a day or until the rat fed when the grid was not electrified and went to the platform when it was.

II. The training trials; rats run in pairs

Day 1-40. 12 trials, each trial 2 minutes long. Grid electrified, food available to one rat if the other rat was on the platform which cut off the shock and opened the food crock.

III. The test trials: rats run in pairs

Day 41-50. Shock off for the first and last 15″ of each trial.

Day 51-60. Shock off for the first and last 30″ of each trial.

Day 61-70. Shock off for the first and last 45″ of each trial.

Day 71-80. No shock at any time.

With the exception of the fact that the rats were subjected to longer and longer intervals of time during which they could receive no shock under any circumstances the test trials are identical in procedure to the training trials. The same data were obtained and comparisons will be made between the rats' performances at the end of the 40 days of training trials and each 10-day unit of the testing trials.

At the end of the 40 days of training trials the rats were being shocked at 150 microamps and this intensity of shock was held constant for the remainder of the experiment.

RESULTS

A. The training trials

Among the first questions that occur are these: 1. How many times a day do these rats alternate from food crock to platform and platform to food crock? 2. Do they learn to execute these alternations in such a manner that neither rat is shocked? 3. To what extent have they reduced the total number of shocks they receive? Table 2-1 contains the data which answers these questions.

Table 2-1

Pair	Mean Alts.	Mean Ratio	C.R.
1-2	10	21	3.58
3-4	25	94	4.24
5-6	37	1	−2.49

1. Column 2 shows the mean number of alternations each animal-pair made from the food crock to the platform and from the platform to the food crock during the last 5 days of the experiment. This ranges from 10 to 37 a day. 2. In the third column is listed the mean ratio for the last 5 days. This ratio expresses the percentage which the alternations without shock are of the total

number of alternations, and is one of our major indices of cooperation. It ranges from 1 to 94. 3. In the fourth column are listed the critical ratios which express the significance of the difference between the total number of times the rats shock each other during the first and during the last 10 days of the training trials. These ratios include both the shock received while alternating and the shock which the rats administered by one rat's quickly moving on and off the platform, i.e., the shocks which do not result in an alternation. These ratios range from -2.49 to 4.24.

Looking at these alternations in another manner we ask the questions: 1. What is the total number of alternations for the 40 days of the *training* trials? 2. On how many of these alternations did the rats *exchange* positions at the food crock and platform? The answers to these questions are in Table 2-2.

Table 2-2

	Rats 1-2	Rats 3-4	Rats 5-6
Total alternations	818	1054	1812
Per cent which the mutual alternations are of the total alternations	97	98	98

1. The second row shows the total number of times each rat-pair exchanged positions, and below these what percentage of these exchanges are mutual, i.e., one in which the rat at the food crock went to the platform while the rat on the platform came out to the food crock and fed. It ranges from 818 to 1812. The third row shows that with each pair 97 to 98 per cent of these alternations are mutual, i.e., the rats may be said to be "taking turns" on 98 per cent of their shifts in position.

Our next questions concern the feeding responses of the animals. 1. How much do they eat a day? 2. How much weight have they gained during the training trials? Table 2-3 answers these questions.

Table 2-3

Rat	Grams eaten per day	Weight at start of training trials	Weight at end of training trials	Weight gained
1	29	153	191	38
2	21	118	142	24
3	23	128	160	32
4	28	129	177	48
5	18	49	93	44
6	19	64	100	36

1. Column two shows the mean of the number of grams of food eaten per day during the training trials and this ranges from 18 to 29. 2. Columns 3, 4 and 5 give the mean weight of the rats for the first and last 5 days of the

training trials and the weight gained by each rat. They gain from 24 to 48 grams during the training trials.

Next we will want to know (1) how much time the rats spend feeding; (2) how much time they spend together on the platform and the percentage which the latter is of the total time they are together in the apparatus? From Table 2-4 we can see that (1) in column 2 the mean daily feeding time ranges from 1396 to 1425; (2) in column 3 that the animals remain together on the platform 15 to 44 seconds a day, and column 4 that this constitutes from 1 to 3 per cent of the total time they are in the apparatus.

Table 2-4

Rats	Mean daily feeding time	Mean time together on the platform	Percentage
1-2	1425"	15"	1
3-4	1408"	32"	2
5-6	1396"	44"	3

B. The test trials

It would ordinarily be expected that the rats which do poorly in the training trials (called a lower order cooperation since the rats receive a shock when not cooperating) would do even more poorly in the test trials which demand a higher order cooperation, i.e., where no shock was administered. Our next data then should concern itself with a quantitative appraisal of the rats' behavior in a situation in which the shock is systematically reduced until finally it is completely eliminated. Since we find striking differences between the different rat pairs we shall consider them one pair at a time.

Rats 1-2. We shall see this hypothesis well verified in the case of rats 1-2. If the rats can not learn the responses demanded by this situation, one or both of them will starve to death. In the case of this pair of rats No. 2 had died by the 13th day. During the 3 days of the second 10 day interval these rats had alternated only twice and the ratio of alternations without shock to the total alternations was 0. That is, these rats never exchanged positions with each other unless a shock was administered. Rat 1 shocked rat 2 67 times and rat 2 shocked 1, 5 times. Rat 1 fed for 947" a day and rat 2 fed for 124" a day. It is apparent that we can not interpret this behavior as being cooperative with respect to any criteria available in this experiment.

At this point it is necessary to introduce a new ratio. The reader will remember that when the shock is turned off it is possible for both rats to leave the platform and come to the food crock although they can not obtain any food since the lid is closed. We should then have a new ratio to express that percentage of the time during which both rats were at the food crock together as

compared with the total time possible for both of them to be at the food crock together.

In the case of these rats the mean time during which both rats were at the food crock for the 3 days of the second 10-day unit was 51 per cent. Now the shock was off for the first and last 30 seconds of each trial in this unit. During the first 30 seconds both rats were at the food crock most of the time. When the shock was turned on one rat would go to the platform and stay there for the remainder of the trial. So they never did learn that the last 30″ of each trial was available for both of them to go to the food crock together. This 51 per cent might then be interpreted as meaning that they both remained at the food crock almost all of the time which they could possibly remain together there. From this criterion too we find that this pair of rats was almost totally uncooperative and this conclusion supports our expectation from the data obtained in the 40 days of the training trials.

Rats 3–4. Our questions here concern themselves with the extent to which our previously mentioned variables change as we systematically and quantitatively reduce the time during which it is possible for the animals to shock each other. 1. Will they continue to alternate, show high ratios, feed most of the time and in sufficient quantity? 2. Will they consistently maintain an adequate level of performance when the shock is reduced as the experimenter turns it off for longer and longer intervals? 3. When the experimenter reduces the time during which the shock is available will both animals spend more time at the food crock even though the lid of the food crock is closed?

Now let us consider the data for rats 3–4. To reemphasize the shock schedule during the test trials days 41–80: On days 41–50 the shock is turned off for the first and last 15 seconds of each trial, on days 51–60 for the first and last 30 seconds of each trial, on days 61–70 for the first and last 45 seconds of each trial, and on days 71–80 the shock was never turned on at any time. Table 2–5 shows the data for these trials.

Table 2–5

Day	2†	3	4	5	6	7	8	9	10
41–50	40	90	698	662	24	24	6	3	14
51–60	61	93	726	564	22	24	3	2	6.9
61–70	50	95	756	509	23	22	1.4	1.5	8.6
71–80	2.6	*	31	13	3.1	4.8	0	0	96.7

* No ratio is cited here since there were so few alternations.
†Col. 2. Mean number of alternations.
Col. 3. Ratio of total alternations to alternations without shock.
Col. 4. Number of seconds rat 3 feeds.
Col. 5. Number of seconds rat 4 feeds.
Col. 6. Grams food rat 3 eats a day.
Col. 7. Grams food rat 4 eats a day.
Col. 8. Number of shocks rat 3 receives a day.
Col. 9. Number of shocks rat 4 receives a day.
Col. 10. Percentage which the actual time during which both rats remain together at the food crock is of the total possible time for both to remain together at the food crock.

Considering days 41–70 during which the shock was progressively reduced but not eliminated entirely, we can see that as we progressively reduce the shock the rats continue to alternate (column 2), they maintain a very high ratio of total alternations to alternations avoiding shock (column 3), they feed adequately and each rat about the same amount (columns 4 and 5 and 6 and 7), and administer progressively fewer shocks to each other (columns 8 and 9). Finally we see that although more and more time becomes available for both rats to remain at the food crock together, they spent in all instances less than 15 per cent of this time actually together at the food crock (column 10).

Finally we must consider the data for days 71–80. On these trials no shock was ever administered but the food crock closed unless one animal was on the platform. Now what will happen to the cooperative behavior? In this case the cooperative behavior breaks down entirely: the rats do not alternate, they spend 96.7 per cent of the time in the apparatus together at the food crock. What little food is obtained, is obtained by one rat's or the other going to the platform, opening the food crock for an instant and then returning to the platform immediately. During this instant that the food crock is open the feeding rat ducks his head into it and seizes a morsel of food and in this manner he obtains the only food he gets. By the 81st. day rat 3 was dead.

Rats 5–6. We ask precisely the same questions in the case of this pair of animals as we did of rats 3–4. Rats 5–6 also lived long enough to yield the data pertinent to these questions. These data are presented in Table 2–6.

Table 2–6

Day	2*	3	4	5	6	7	8	9	10
41–50	22	18	814	346	17	15	52	17	74
51–60	14	11	645	259	14	11	47	10	73
61–70	18	29	429	173	16	12	27	11	75
71–74	1	†	13	40	1.5	7	0	0	96

*See table 5 for headings of columns.
†No ratio is cited here since there were so few alternations.

By the 75th day rat No. 6 was dead. The data in Table 2–6 indicates that these rats show relatively few alternations (col. 2); very low ratios of total alternations to alternations without shock (col. 3); the feeding times show a progressive decrease as the shock is eliminated (cols. 4 and 5); the rats shock each other considerably even as the amount of time during which the shock is on is decreased (cols. 8 and 9). They did, however, obtain sufficient food to remain in a fairly vigorous condition until the shock was entirely eliminated (cols. 6 and 7). They spent 73 to 75 per cent of the total possible time together at the food crock (col. 10). When the shock was eliminated altogether (days 71–75) they spent an average of 96 per cent of the time together at the closed

food crock and this eventuated in rat No. 6's death and severe inanition for rat No. 5.

CONCLUSIONS AND INTERPRETATIONS

In general we find a rather consistent relation between the rats' performance in the training trials and the test trials. In the case of these three pairs of rats we find that the higher their degree of performance on each variable measured in the training trials the higher their degree of performance will be on each variable measured in the test trials.

Our initial hypothesis that the test trials represent a higher order cooperation than the training trials seems to be verified in the case of these rats. It is suggested also that each 10 day unit of the test trials might represent a differentiable step in the ladder to the highest order cooperation, namely, cooperation with no shock. Neither the writer nor the data imply that any pair of rats cooperated when the shock was entirely eliminated. It is obvious, however, that 2 pairs of rats (particularly rats 3-4) continued to cooperate when there are only a very few shocks administered each day. It seems, then, in this situation at least, that as long as some shock or the threat or expectation of shock is present, the rats will continue to cooperate if: (1) they have shown a reliable and significant decrease in the number of shocks not resulting in an alternation, i.e., if the rats receive fewer and fewer shocks but continue to alternate and (2) if the ratio of total alternations to alternations without shock is about 90 or more at the end of the 40 days in the training series. This conclusion of course, will have to be verified by future experiments.

The striking breakdown in the behavior under the no-shock condition (days 71-80) is urgently in need of explanation. Behaviorally there is a vast difference between the threat of shock reinforced by a few actual shocks, and no shock at all.

In this experiment the situation demands that a rat under a strong hunger drive desert this food and go to a platform, even though he could work on the food cap and try to force it off the food crock. In the event that it does go to the platform that rat's reward is a chance to see and smell food as its cage mate is eating it. A small reward indeed! Since all the rat's drive is toward the food and none toward the platform, since the shock is never turned on, and since the learning that continued alternations is the only solution to the problem apparently lies beyond the rat's capacity in this situation the cooperative behavior disappears. But remnants of it are still there. The rats were often seen making abortive movements toward the platform, i.e., they turned toward it but did not go all the way. Or they made a very quick return to the platform, depressed it and dashed back to the food crock. In some instances they licked the food off the lip of the food cap or sometimes they took it from the mouth of the rat who had remained at the food crock.

It seems possible in this experiment then that the food is responsible for the rat's leaving the platform, but it is not responsible for their returning to the platform. Apparently the shock and the threat of shock is responsible for this. Then with the total absence of shock, cooperation disappears. It seems that some degree of duress (shock) is essential to the establishment and maintenance of cooperative behavior in this situation. However the feeding rat did go back to the platform when the shock was on. It continued to return to the platform when the shock was turned off for greater and greater percentages of each trial's time. The rats continued to alternate as much or more than they did when the shock was always present. Even when the shock was turned off for 75 per cent of each trial's time there is no deterioration in any of the criteria by which we have been measuring their cooperativeness.

On the other hand there must be *some* shock since the cooperative behavior disintegrated when *all* shock was removed. In other words, so long as *some* threat of shock was present the animals continued to alternate at a high level. It may be concluded then, that the returns to the platform were essentially the results of the shock or, and this is significant, the threat of shock. In brief, the cooperative behavior in this situation required the presence of some punishment.

Some qualitative observations

We might be justified in calling the non-cooperative behavior of rats 5 and 6 "a-social," at least in terms of the variables with which we dealt. The "a-social" character of the behavior of these animals is further evidenced by some qualitative observations. Both of these rats appeared to be responding only to the "a-social," i.e., physiological aspects of the situation: to the food and to the shock. They never did learn to use each other's movements, positional shifts, nudges, etc., as cues for their reactions in the apparatus, as did the cooperative animals. Stated more broadly, their responses seemed to be directed toward avoiding shock and obtaining food. The more cooperative animals, especially 3 and 4, not only responded in this manner but in addition learned to respond to each other as cues for the avoiding of shock and the obtaining of food.

SUMMARY

A box was constructed with a grid floor which could be electrified with a platform at one end which shorted out the grid when a rat stepped on it, and a food crock flush with the grid and just beyond the reach of the rat on the platform. A food cap, operated by a noiseless solenoid was wired into the platform in such a manner that it snapped over the food crock when the platform was not depressed.

White rats were trained individually to go to the food crock and feed when the grid was not electrified and to go to the platform and remain on it when the grid was electrified.

The rats were next run in pairs. In these training trials so long as one rat was on the platform the grid was not electrified, the food cap was off the food crock, and the other rat could feed. In this situation the rats learned to "take turns" and to do this more and more in such a manner as to avoid shock, to decrease the shock, and to get fed adequately.

In the test trials the shock was systematically reduced until finally no shock was ever used, so that the rats never could get shocked. Cooperative alternating in this situation was considered a higher order of cooperation. The results were:

1. The rats' previous behavior was a good indicator of their later behavior in the more difficult situation, i.e., one involving a higher order cooperation.

2. The rats reached varying degrees of higher order cooperation with consistent changes in all the variables measured.

3. None of the rats cooperated when no shock was ever administered.

Some shock seems essential to the establishment of cooperative behavior but it can be used less and less. Finally, in those cases in which 90 per cent of the alternations are accomplished without shock a very few shocks plus the threat of shock will be sufficient to sustain the cooperative behavior at a level as high and higher, in some respects, than that shown at the end of the training trials.

In the training trials the animals satisfied both motives to some extent in a situation in which the satisfaction of both these motives was contingent upon the synchronized responses of both animals. In the test trials, with the systematic reduction of the adequate stimulus for one of these motives (escape from shock) the cooperative behavior can be maintained by some rats, but with its total elimination the cooperative behavior breaks down.

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An experimental social relation between two monkeys

John J. Boren

This research was concerned with a basic social interaction—the reinforcement of one organism by another. The aim was to develop a technique for studying this interaction in the laboratory under clearly defined circumstances. The technique was arranged to permit some aspects of a controlled laboratory environment and some aspects of naturalistic observations. The advantages sought were a setting where naturalistic social phenomena could be studied, where the social behavior could be submitted to an experimental analysis, where the behavior could be observed objectively, and where a record of the entire development of the social interaction could be obtained.

Laboratory studies with similar objectives have been described. Baron and Littman (1961), following an unpublished demonstration by O. H. Mowrer, put a pair of rats in a box with a lever at one end and a food pellet dispenser at the other end. The problem was that when one rat pressed the lever and produced a pellet, the other rat, waiting at the other end of the box, ate the food. In eight out of nine pairs the response rates of both rats declined to low levels after 10–20 sessions. However, one pair developed a worker-"parasite" relation where one rat did all of the lever-pressing. The authors explained this pattern by noting that the worker rat often pressed many times in rapid succession to produce a pile of food pellets. Then, the worker ate a portion of the pellets before the parasite could consume them.

Other related studies have dealt with "altruistic" behavior in animals. Rice and Gainer (1962) described a situation in which one animal would relieve another animal's "distress". The distress was produced by suspending a rat from the floor in a harness. It was found that a second rat would press a lever to lower the suspended and squealing rat to the floor. In another experiment on "altruism" in animals, Massermann, Wechkin, and Terris (1964) arranged that a rhesus monkey would be reinforced with food for pulling a chain in either of two stimulus lights. However, a second monkey would be shocked after a chain pull in one of the lights. Twelve out of 15 experimental monkeys decreased chain pulling in the stimulus where the response produced

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food plus shock-to-the-other-monkey. Using humans as subjects, social interactions have often been explored in the laboratory. Human studies especially relevant to the present research were published by Azrin and Lindsley (1956), Sidowski, Wyckoff, and Tabory (1956), and Lindsley (1963).

For the present experiment a laboratory technique was devised to study a situation in which two monkeys reinforce each other (*i.e.*, the interreinforcement process). The monkeys were placed in adjoining chambers with only an open grill between them. The social interaction of interest required the operation of levers. Each monkey's chamber contained a lever and a food pellet dispenser. Unlike the usual experimental arrangement, however, when monkey A pressed its lever, monkey B's pellet dispenser operated; and when monkey B pressed its lever, monkey A's pellet dispenser operated. Within this context lay a basic problem: could a stable social relationship be established and maintained under these conditions? More specifically, how could the two monkeys be trained to feed each other? Then, if they could be so trained, would they continue to give each other an adequate diet when the special training conditions were removed?

METHOD

Subjects

Four stumptail macaque monkeys (*Macaca speciosa*) were divided into two pairs. Both members of the first pair (Si and Al) were males, while the second pair included one male (Fib) and one female (Moll).

Apparatus

Each monkey was housed 24 hr a day in an operant conditioning chamber (Foringer and Co.) with grills on the floor and one side. On one wall were three levers, a food pellet dispenser (for .8 g Dietrich and Gambrill pellets), and a water dispenser. When the lever farthest from the front grill was pressed 11 times, about 8 ml of water was released into a tube which the monkey could suck. The front lever was unused in this experiment. The center lever operated the pellet dispenser in the other monkey's chamber. A small projector (Industrial Electronic Engineers, Inc.) above the center lever was used to present visual stimuli.

The two chambers for each pair of monkeys could be pushed together so that the grills were separated by less than 1 in., thus creating many possibilities for social interaction. For example, grooming could easily take place. They could also hear the pellet dispensers, see the other monkey eat, hear the

rattle of the levers, *etc.* The grill prevented such interactions as copulation and fighting.

The experimental procedures were programmed by relay equipment. A "white" masking noise prevented the monkeys from being disturbed by relay clicks or extraneous sounds.

Procedure

The first goal was to train each pair of monkeys to reinforce each other with food. The following methods were devised. The monkeys were first trained individually to press the center lever by reinforcing each response with a food pellet. Then, to permit them to tolerate the delays of reinforcement likely to occur when the two monkeys were placed together, the individual monkeys were taught to press a lever and then to wait a period of time until the pellet was delivered.

With the first pair (Si and Al), red and white stimulus lights were used to facilitate training. If the monkey pressed the lever when the white light was on, the red light replaced it. Then, after a delay, a pellet was delivered. The delay was first set at 0.5 sec and was gradually lengthened to 30 sec over 11 daily sessions. Any lever press in the red light extended the delay period. When the final performance was established, the white light came on, serving as an S^D for lever pressing; if the monkey pressed its lever, then the red light came on, serving as an immediate conditioned reinforcement; and, after a variable delay ranging from 1 to 30 sec, the pellet was delivered in the presence of the red light. This procedure employed a technique for maintaining behavior with prolonged delays of reinforcement described by Ferster (1953), Azzi, Fix, Keller, and Rocha e Silva (1964), and Ferster and Hammer (1965).

The next step was to train the animals to reinforce each other. Two monkeys were placed in adjacent cages with each monkey's lever arranged to operate the other's pellet dispenser. In Si's cage the white light was on, and in Al's cage the red light was on. When Si pressed the lever, Al received a pellet in the presence of a red light. Immediately Si's light turned red and Al's white. When Al pressed, Si received a pellet and so on. Note that the stimulus conditions and response requirements in the social situation were consistent with the individual pre-training situation. The procedure was successful in that the monkeys responded quickly during the first session they were together and within 1 hr had fed each other a normal daily ration. By the nature of the procedure the monkeys were alternating food reinforcements on a one-for-one, *quid pro quo* basis.

Several refinements were added to this basic alternation procedure. (1) If one monkey tried to press its lever "out of turn" in the red light, then the stimulus lights and the house lights were turned off for both monkeys and no reinforcements were delivered. This time out condition lasted for 5 sec. (2)

The schedule of reinforcement was changed gradually in steps from continuous reinforcement to a fixed ratio of 32 (FR 32), *i.e.*, each monkey had to press its lever 32 times to operate the other monkey's pellet dispenser. (3) The final step was to replace the alternating red and white lights with a steady, unchanging blue triangle. The blue triangle came on when the session began and remained until each monkey had received its daily ration of 70 pellets. The monkeys' cages were together continuously even though the food session was not in effect.

The second pair of monkeys (Fib and Moll) was pre-trained in a different way. The experimental work was based upon the same principles used with the first pair, but several details were changed. Although the delay-of-reinforcement training of the individual monkeys was programmed the same way, the alternating red and white lights were not used. The steady blue triangle was on throughout the delay-of-reinforcement training and served as a "session-on" signal. The alternation procedure was not used. After training on variable delay of reinforcement, the two monkeys were placed side-by-side in the social situation and permitted to reinforce each other on the free responding procedure described below. They remained on a continuous reinforcement schedule throughout.

As described in the Results section, the training procedure established the desired behavior: both pairs of monkeys fed each other. This was particularly clear for the first pair (Si and Al) since they fed each other stably on the alternation procedure from session 28 through session 83. The final phase of the experiment determined if the monkeys would reliably feed each other when no restrictions were imposed by the experimenter. For both pairs a free responding procedure was arranged so that the monkeys of a pair could reinforce each other in any order at any time. With Si and Al, 32 lever presses were required; with Fib and Moll only one. Otherwise, no restrictions were imposed. The number of sessions devoted to each phase of the experiment are shown in Figures 2-2 and 2-7.

With Si and Al, a daily session was continued until 140 pellets had been divided between the two monkeys. After the session, each monkey was given an orange. With Fib and Moll, the session continued until one monkey received approximately 70 pellets. Then the other was hand fed enough additional pellets to make a total of 70 for the day. These monkeys were also given an orange after the session.

RESULTS

The cumulative records in Figure 2-1 show the final performance established in Si and Al by the alternation procedure. The monkeys responded quite

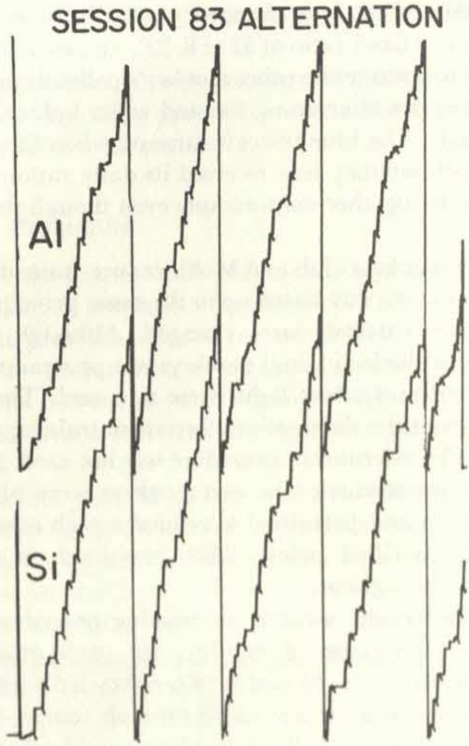

Figure 2-1. Final performance established by the alternation procedure. Two cumulative recorders with the same paper speed registered the lever-pressing behavior and the reinforcements for each monkey. For example, the upper record shows Al's lever-pressing and food reinforcements—although the food pellets were produced by Si's behavior. The figure was constructed by making triangular cuts in the records and pushing them together for close comparison. To illustrate from the beginning of the above records, Al made the first run of 32 responses, as shown by the first upward excursion of the pen; the first pellet was thereby delivered to Si, as indicated by the first pip on Si's record. Both pens reset to the baseline at the same time so that the two records could be easily lined up. The time covered by the records shown above was 45 min. The maximum excursion of the pen from baseline to reset point was 540 responses.

rapidly and delivered to each other their daily food ration in less than 1 hr. The run of 32 responses usually occurred without pausing, and each monkey typically stopped responding immediately after the pellet was delivered to the other monkey. For this reason the pause preceded the reinforcement marked in Figure 2-1. With the alternation procedure, behavior was stable from session to session, the fixed ratio characteristics were well maintained, and the general performance would presumably have been maintained indefinitely. In summary, Figure 2-1 shows that the first objective of the experiment had been realized. The technique was effective in training and maintaining the social relation of interreinforcement. Although knowledge of the procedure

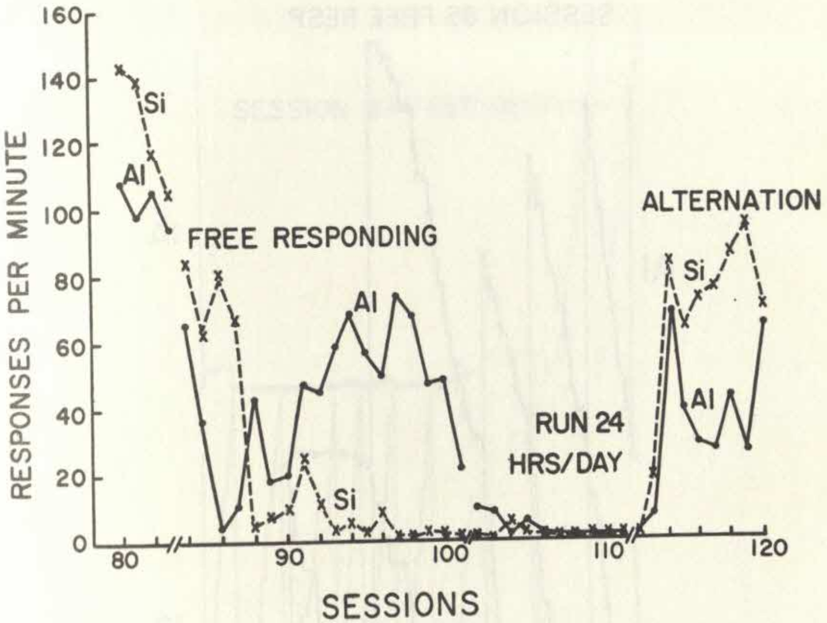

Figure 2-2. Changes in response rate during the course of the experiment for Si and Al.

makes clear how each monkey was individually controlled, an outside observer might note only that the monkeys worked to give food to each other.

Figure 2-2 shows for Si and Al the session-by-session course of the experiment. The first four points (sessions 80-83) illustrate the final high rates of responding generated by the alternation behavior. Rates of 100-140 responses per min were common. On session 84 the alternation requirement was discontinued, and the free responding procedure began whereby each monkey could press its lever and deliver pellets to the other monkey in any order at any time. Although the rates appear to be lower in session 84 than before the procedural change, the change is largely due to the method of calculation. With the alternation technique the denominator used in calculating the response rate was only the time that one monkey was actually "on" and due to respond (about half the session), but with the free responding procedure, the denominator had to be the total session time. Thus, the rates under free responding should be roughly doubled to compare them directly with the rates under alternation.

Both monkeys maintained relatively high rates the first two sessions (84 and 85) under the free responding procedure. By session 86, however, Al's rate had dropped very low. Figure 2-3 (cumulative records of session 85) shows how the transition took place. At the beginning of this session (as during the entire first session) both monkeys responded rapidly (sometimes simul-

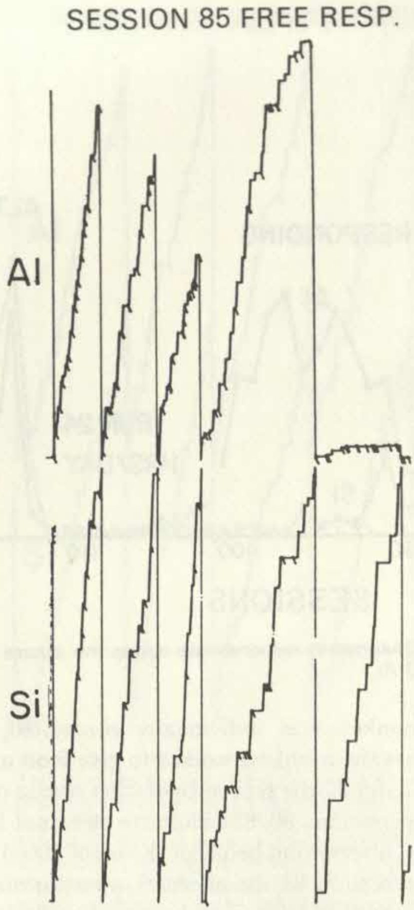

Figure 2–3. Cumulative records of session 85, the second session of the free responding procedure. The upper record shows the transition point at which the response rate for Al decreased sharply. (Time of the above records: 44.9 min; response scale: 540 responses maximum excursion from baseline to reset point.)

taneously) so that they received a similar number of pellets. At the end of the session, however, an important change took place. At approximately the fourth reset of the recorder in Figure 2–3, Al stopped responding and Si continued. The result was that Al received a number of reinforcements for sitting and not responding. The seeds of social instability had been sown.

This pattern continued through session 86 and most of session 87 and accounts for the low rate shown for Al and the high rate shown for Si in Figure 2–2. As illustrated in Figure 2–4 (cumulative records for session 87), Si did most of the responding while Al did most of the eating. By the sixth excursion

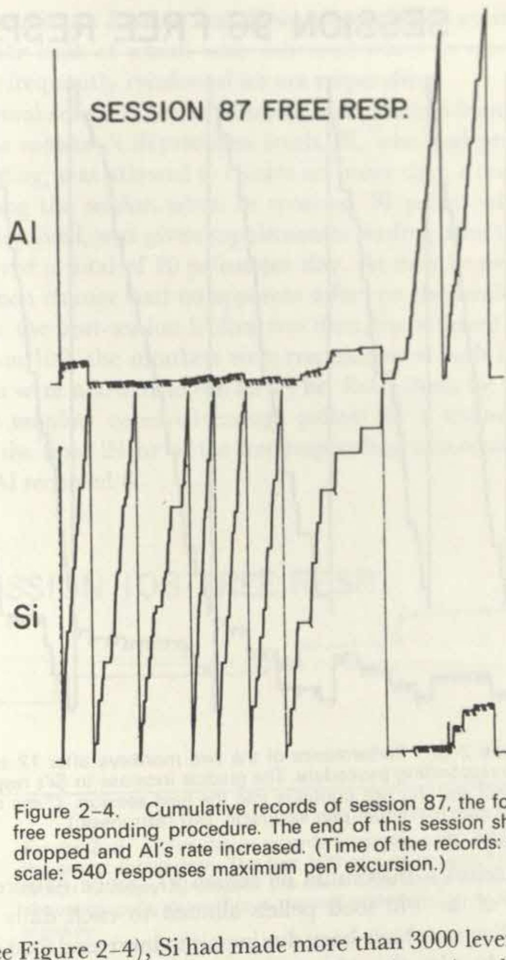

Figure 2-4. Cumulative records of session 87, the fourth session of the free responding procedure. The end of this session shows how Si's rate dropped and Al's rate increased. (Time of the records: 57.4 min; response scale: 540 responses maximum pen excursion.)

of the pen (see Figure 2-4), Si had made more than 3000 lever presses but had received only two reinforcements from Al. A short time later (before the seventh pen excursion), Si began to pause for long periods—a behavioral consequence which probably resulted from the large amount of responding and the small amount of reinforcement. A second consequence of Si's pausing was that the reinforcement frequency for Al dropped. At this point Al's rate increased sharply while Si sat and received a number of pellets. While the reason for the sharp change in Al's behavior is not definitely known, Al's extensive past history with the alternation procedure was probably involved. With that procedure, the reinforcement frequency was increased by responding, since after one monkey emitted a run of responses, it usually received a pellet back from the other monkey.

Although Si had been the higher responder before session 88, Al became the higher responder afterwards. As shown in Figure 2-2, Al's rate increased

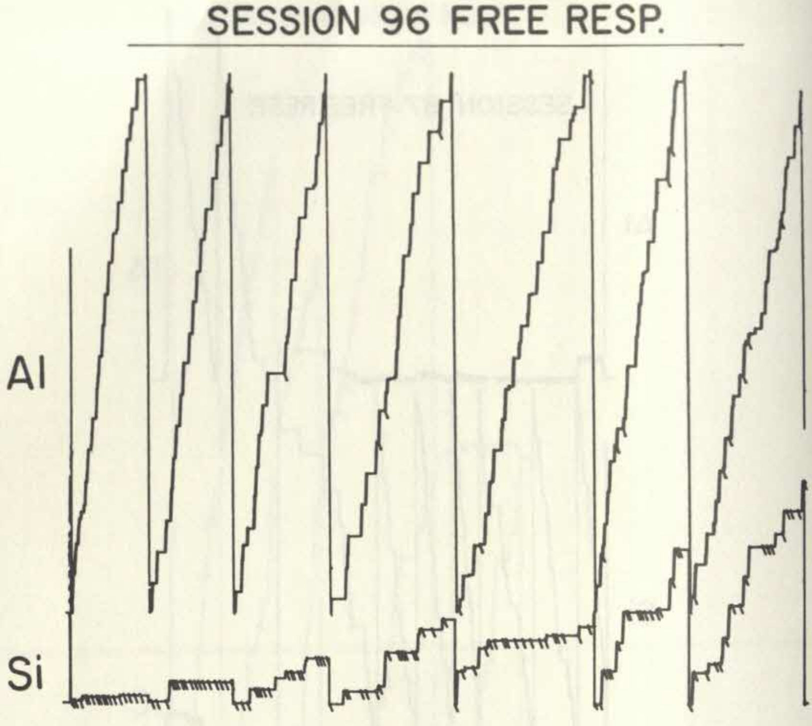

Figure 2–5. Performance of the two monkeys after 12 sessions of the free responding procedure. The gradual increase in Si's responding is not typical and did not continue into the next session. (Time of the records: 77.4 min; maximum pen excursion: 540 responses.)

gradually and reached a maximum on session 97. Since Al received only a small proportion of the 140 food pellets allotted to each daily session, the increased responding may have been due in part to increased food deprivation. However, the results with the other two monkeys (and later work with these monkeys) where deprivation was held constant indicated that increased deprivation was not an essential variable for this type of result. A picture of representative cumulative records for this period is shown in Figure 2–5. Al's overall high rate was formed of runs of 32 responses followed by brief pauses. The termination of the run and the initiation of the pause coincided with the click of Si's pellet dispenser and the delivery of the pellet. Si's pattern was usually the same. This performance pattern indicates that each monkey was influenced by the delivery of food to the other.

After session 97, Al's response rate decreased steadily, an effect which would seem to follow from the low rate of reinforcement. From sessions 97–101 Al made more than 4000 responses per session but received an average of only five pellets. At the same time Si's rate remained at its usual low level. The

probable reason is not hard to find. Si was receiving an average of 135 pellets per session, the bulk of which were delivered when he was not responding. Thus, Si was frequently reinforced for not responding.

The normal course of the experiment was changed from sessions 102–106 to modify the monkey's deprivation levels. Si, who had previously received excessive feeding, was allowed to receive no more than a normal daily ration by terminating the session when he received 70 pellets; then Al, who was excessively deprived, was given supplemental feeding after the session so that he also received a total of 70 pellets per day. As may be seen in Figure 2–2, this deprivation change had no apparent effect on the results. Except for the usual orange, the post-session feeding was then discontinued after session 106.

By session 107, the monkeys were responding at such low rates that the daily sessions were allowed to run for 24 hr. Even then, the rates were so low that neither monkey received enough pellets for a maintenance diet. On session 111, the final 24 hr of the free responding procedure, Si received 29 pellets and Al received 8.

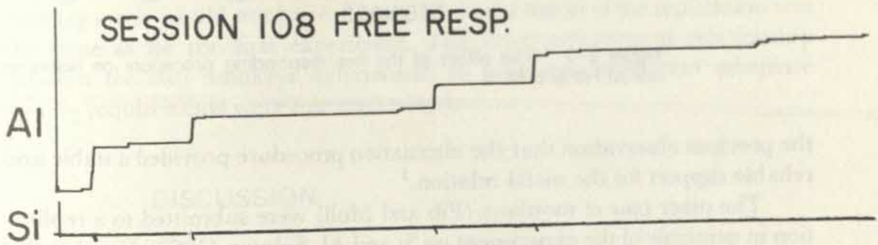

Figure 2–6. Cumulative records illustrating the final behavioral state of the social interaction. The first 100 min of session 108 are shown during which monkey Al pressed the lever 169 times. Following the end of the above records, many hours passed with little or no responding by either monkey.

The state of the behavior is illustrated in Figure 2–6 here, showing the beginning of session 108. Only a few responses were emitted by Al and none by Si. Following the time shown in Figure 2–6, many hours passed with few or no responses by either monkey. It was apparent that the interreinforcement relationship had deteriorated to a very low level, and the likely final consequence was that both animals would eventually starve to death.

At this point, due to concern for the monkey's health, the procedure was changed back to the alternation requirement. The change was without effect the first session (see session 112 in Fig. 2–2) so that Si received 11 pellets and Al 12 pellets during the 24 hr session. By the third session (session 113), however, the behavior of both monkeys had recovered so successfully that each received 70 pellets within 59 min. The continued high rates of performance confirmed

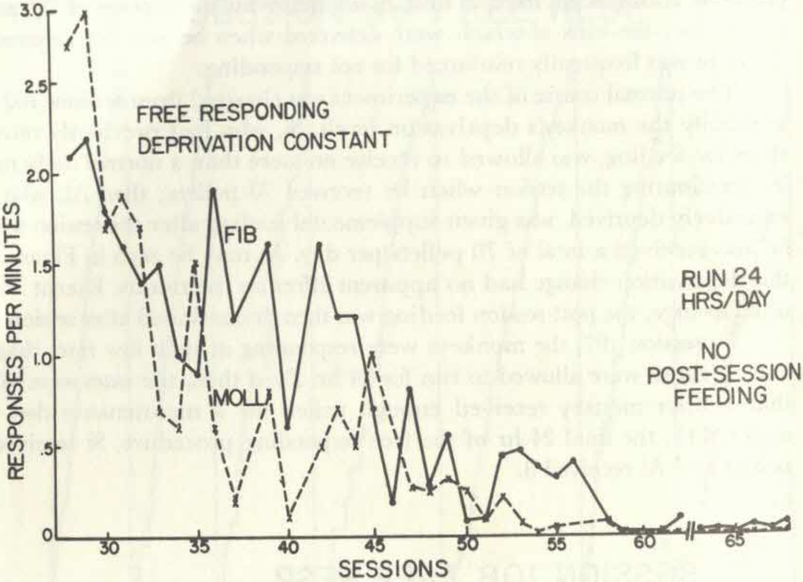

Figure 2–7. The effect of the free responding procedure on response rate of Fib and Moll.

the previous observation that the alternation procedure provided a stable and reliable support for the social relation.[1]

The other pair of monkeys (Fib and Moll) were submitted to a replication in principle of the experiment on Si and Al. Sidman (1960) describes this type of experiment as a "systematic replication" which examines the generality of the basic procedure. The replication differed from the original experiment in that the members of the pair were opposite in sex, the pre-training procedure did not include stimuli during delay training or alternation training, the reinforcement schedule was continuous reinforcement, and food deprivation was held constant by post-session feeding. However, the replication retained the principle of pretraining the monkeys by a delayed reinforcement procedure before determining if they would feed each other under the free responding procedure.

The results of the replication are shown in Figure 2–7 in terms of response rates. The rates of both monkeys were quite well maintained for the first five sessions (sessions 28–32). The two monkeys averaged two responses per minute so that four pellets a minute were exchanged. The initial two sessions required less than 30 min for one monkey (Fib) to receive its daily ration

[1] Since this study was completed, further experimental work has added to the interpretation of this relation as "social". For example, the performance drops to quite low rates when a door is closed between the two monkeys or when one monkey is temporarily removed from its chamber.

while the next three sessions required an average of only 43 min. Thus, simplified pre-training successfully established the interreinforcement relationship.

Although systematically declining, the relationship continued at a substantial rate for a number of sessions. Even at session 45, for example, the rates were 1 response per min for Moll and 0.7 response per min for Fib; in 76 min Fib received 100% of his ration while Moll received 81%

The trend, however, was always downward so that by session 57 the response rates approached near-zero levels. At this point, in order to maintain a constant deprivation, the sessions were terminated after 8 hr for the usual post-session feeding, even though neither monkeys received 70 pellets. As shown in Figure 2–7, the near zero rates continued.

Finally, on session 63 the conditions were made more stringent to see if higher response rates could be recovered. The post-session feeding was discontinued so that the deprivation level could increase, and the sessions were allowed to run 24 hr a day. Over the next five days Moll received an average of 38.6 pellets a day while Fib received only 6.4. Although the first monkey might have survived for a substantial time at this dietary level the second monkey surely would not have. The general conclusion of the replication was the same as for the first experiment. The interreinforcement relationship between the two monkeys deteriorated to such low levels that adequate dietary requirements were not maintained.

DISCUSSION

This study has described: (1) a technique for studying a social relation between two animals, including a training procedure; (2) an alternation procedure for maintaining a stable social relation; and (3) the finding that the social relation will not be reliably maintained by a free responding procedure.

The social situation contained aspects of both a free, naturalistic environment and a controlled laboratory study. The experiment dealt with the phenomenon of interreinforcement which has been reported in both the ethological and experimental literature. For example, Furaya (1957) reported that feral Japanese monkeys often groom each other, and Goodall (1965) described mutual grooming in chimpanzees as one of the most important social activities. Reciprocal food sharing has been reported in juvenile gibbons by Berkson and Schusterman (1964), and Itani (1958) has observed a dominant monkey to give up food to an inferior monkey after mounting it. Miles (1963) tells of observing an old male chimpanzee who delicately removed a cinder from the eye of his female mate.

As in a natural environment, the subjects of the present experiment and the basic situation (rather than the experimenter) exercised control over the critical variables. On the other hand, the laboratory contributed (1) the

special environment of chamber, levers, pellet dispensers, *etc.* which set some of the conditions of the experiment; (2) the experimental analysis of the social interaction; (3) the past history of training which established the interreinforcement repertoire; and (4) the objective recording of the social behavior. The recording was particularly important because it permitted an understanding of how the social interaction developed. A similar history in the natural environment is extremely difficult to acquire.

In this study a technique was found to establish an interreinforcement relationship. The pre-training involved alternation of reinforcements and/or delay of reinforcement. As long as the procedure coerced an alternation of reinforcements, a pair of subjects worked rapidly and reliably provided a daily ration for each other. However, with the non-coercive, free responding procedure, the social relation proved to be unstable. After one or more oscillations of "taking turns" in which one monkey did most of the work and the other did most of the eating, the interaction deteriorated to a very low level; starvation was the probable outcome had the experimenter not intervened. Both pairs of monkeys showed the same terminal pattern after somewhat different pre-training and under somewhat different conditions.

One major source of social instability was the reinforcement of non-social behavior. The free responding procedure permitted one monkey to reinforce the other merely for sitting and eating. As a consequence, the frequency of sitting and eating increased. A second major source of instability interacted with the first. When the sitting monkey was reinforced for non-responding, the working monkey was then forced to respond many times without reinforcement, or at least with extremely delayed reinforcement. Thus, responding by one monkey to feed the other was likely to be inadequately reinforced. Both sources of instability combined to reduce the frequency of the social behavior.

The above analysis is supported by the successful maintenance of the interreinforcement relationship on the alternation procedure. This procedure does not permit the inappropriate reinforcement of non-responding since one monkey cannot receive even two pellets in a row for sitting. At the same time the alternation procedure is more likely to reinforce appropriate responding. A monkey can increase its own frequency of reinforcement by responding and delivering a reinforcement to the other monkey. Since a pellet is often returned quickly, the social behavior is likely to be adequately reinforced.

The above analysis of the social interaction emphasizes the reinforcement contingencies of the individual member of the social pair. The approach is to explain how the relevant variables affect the individual participant. In this way the interaction can be accounted for by established principles of individual behavior without requiring special "social" formulations. From this point of view the major problem of the analysis seems to be the complexity of the social interaction due to the inconsistency, the intermittency, and the number of controlling variables programmed by one organism for another.

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A method for studying altruism in monkeys

Arthur D. Colman,
Klaus E. Liebold
and
John J. Boren

In 1962, Rice and Gainer showed that rats would lever press more to lower a rat squealing in a harness than to lower a block of styrofoam similarly suspended. They considered this "altruistic" behavior since it was presumably controlled by relieving another animal's "distress." In 1964, Masserman, Wechkin, and Terris demonstrated a similar phenomenon in rhesus monkeys. In their experiment, monkeys were reinforced by food for pulling either of two chains. One chain produced only food while the other produced food plus shock to a nearby monkey. Ten out of fifteen monkeys pulled less on the latter chain, thereby avoiding the response which shocked the nearby monkey.

Experimental evidence of altruistic behavior controlled by non-aversive social variables, specifically situations requiring positive reinforcement (reward) of another monkey, have been more difficult to obtain. For example, Wolfe and Wolfe (1939) taught four pairs of monkeys to pull a lever that would bring a cup, either empty or containing food, to their partners. Four of the monkeys behaved similarly whether or not the cup had food in it, indicating no preference for feeding the other monkey. The other four pairs worked equally rapidly to bring food to an empty cage. The authors concluded that "none of them showed any evidence of behavior which would be called co-operative." Baron and Litman (1961) put two rats in a box with a lever at one end and a pellet dispenser at the other. In eight of nine pairs, the response rate declined to low levels in ten to twenty sessions. When one rat worked at the lever, the other waited at the food tray and ate the pellet, so the worker rat eventually stopped lever pressing. In the ninth pair, one rat continued to maintain a high rate of lever pressing. The authors noted that this worker rat pressed many times in rapid succession to produce a pile of pellets and then ate some of the leftovers of the "parasite" rat.

In 1966, Boren reported a technique for studying the reinforcement of one organism by another. He trained two pairs of monkeys (each separately caged but in visual, aural, and tactile contact with its partner) to press a

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lever which would feed the other. Then the monkeys were placed in a free responding procedure where they could work at any time and in any order. This "social relationship" proved unstable for, after a series of oscillations in which one monkey did most of the responding and the other most of the eating, the reinforcement frequency for both decreased to very low levels. Boren reported that the final outcome would have been starvation had the experiment not been terminated. A major source of this social instability was the reinforcement of non-social behavior. The non-working monkey was reinforced by receiving pellets for sitting; as a consequence, it did not provide reinforcement for the working monkey. The failure to demonstrate experimentally that feeding a monkey is reinforcing to the feeder monkey is surprising in view of ethological observations of mutually reinforcing behaviors, such as grooming, in several species of primates (Berkson & Schusterman, 1964; Furaya, 1965; Goodall, 1965).

The goal of the present study was to develop a new technique for investigating altruistic behavior. The technique was designed to avoid reinforcing non-social behavior (found previously) and to be more sensitive to possible reinforcing effects of feeding another organism. The new technique allowed one monkey to feed itself by pressing one lever or to feed both itself and another monkey by pressing a different lever. Since the food reinforcement for pressing either lever was identical, slight additional reinforcement from feeding another monkey should result in a lever preference.

METHOD

Subjects

Four monkeys, a pair of *macaca mulatta* (both males), and a pair of *macaca speciosa* (male and female) served as subjects. The *macaca mulatta* monkeys will be referred to as monkeys S and L while the *macaca speciosa* will be designated A and M (the female). Monkeys S and L had served as subjects for 137 sessions in previous experiments of the same general type as the present one, and monkeys A and M had served 158 sessions. Dominance testing (arranged by putting one piece of food between the two monkeys while in the same cage) showed that monkey S was dominant over L, and A over M.

Apparatus

Each monkey was housed continuously in an operant conditioning chamber (Foringer and Company) with grills on the floor and front side. The chamber

was equipped with a food pellet dispenser, a houselight, a one inch projection cell for visual stimuli, and three levers. Only the front lever and the center lever were used in the experiment. The rear lever gave access to water. For each pair of monkeys, the chambers were placed about one foot apart so the monkeys could observe each other. Experimental procedures were programmed automatically by relay circuitry. "White" noise masked relay clicks and extraneous sounds.

Procedure

Each monkey could choose between two levers. If it pressed one lever, it fed itself only; if it pressed the other lever, it fed both itself and the neighboring monkey. Two thirds of the trials allowed the working monkey a "free choice" between the two levers, while the other third of the trials were "forced" to one lever or the other. The "forced trials" made sure that the monkey periodically sampled the consequences of both reinforcement conditions. The procedure which forced each monkey to press both levers was as follows: when a white square with a green background appeared on the projection cell, presses on the front lever were reinforced. When a white circle was projected on the green background, presses on the center lever were reinforced. A press on the wrong lever resulted in a 10 second time-out period, during which the stimulus lights were off and the reinforcement was unavailable.

In both "forced" and "free" trials, the lever which fed both monkeys reinforced the neighboring monkey on the first press and the working monkey on the 36th press (a fixed ratio of 36); the lever which fed only the working monkey reinforced on the 36th press. Each pellet delivery was accompanied by a 3 second light over the pellet hopper. Thus, each monkey could easily discriminate his own or his neighbor's pellet delivery. An intertrial interval of 3 minutes for monkeys S and L and 5 minutes for A and M followed each reinforcement. During a given experimental session each lever would mediate one of the two reinforcement conditions. After a number of sessions, depending upon the time required for the monkey's behavior to stabilize, the levers were switched to the other reinforcement condition.

A preliminary experiment was carried out to ensure that the basic procedure was adequate to detect reinforcement preferences. The procedure differed from that described above by arranging that one lever reinforced the worker with two food pellets while the other lever reinforced with one pellet (the neighboring monkey was not involved). Each of the four monkeys showed better than a 90% preference for the lever delivering two pellets. When the lever delivering two pellets was switched, all monkeys changed to a 90% or better preference for the two-pellet lever within 5 sessions or less. (The long intertrial intervals, 3-5 minutes, were critical in producing these clear-cut preferences.) These results established that the experimental procedure was

sensitive enough to measure a preference for a social consequence to or greater than a preference for an extra pellet.

RESULTS

The effects of the social feeding consequences on the behavior of monkeys S and L are shown in Figure 2-8. During the first sessions plotted, sessions 232-237 the front lever fed both monkeys while the center lever fed only the lever-pressing monkey. Under these conditions monkey S's preference was for the front lever, feeding L along with himself. Under the same conditions, monkey L's preference was away from the front lever, feeding only himself and, by default, depriving monkey S of food. In sessions 238-248 the functions of the levers were reversed so that the center lever fed both monkeys and the front lever fed only the lever-pressing monkey. Both monkeys switched levers, thus keeping the social feeding consequences the same. In sessions 249-269, the levers were switched back to the original condition, and the monkeys again changed levers. In sessions 270-276, monkey L was taken out of his cage to test whether monkey S's preference for feeding L was related to non-social stimuli accompanying L's reinforcement, such as the hopper light or the pellet feeder noise. With monkey L out of his cage, monkey S reverted to the center lever.

These results demonstrate that monkeys S and L were responsive to the social feeding consequences. Monkey S preferentially fed monkey L with no net gain of pellets to itself, while monkey L preferentially did *not* feed monkey S under the same conditions. The results further demonstrate that S's "altruistic" behavior required L's presence.

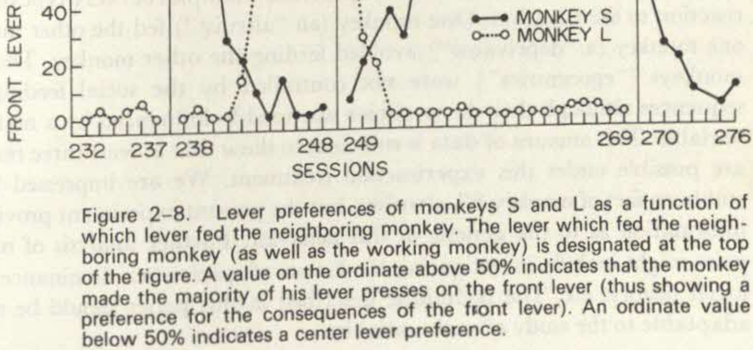

Figure 2-8. Lever preferences of monkeys S and L as a function of which lever fed the neighboring monkey. The lever which fed the neighboring monkey (as well as the working monkey) is designated at the top of the figure. A value on the ordinate above 50% indicates that the monkey made the majority of his lever presses on the front lever (thus showing a preference for the consequences of the front lever). An ordinate value below 50% indicates a center lever preference.

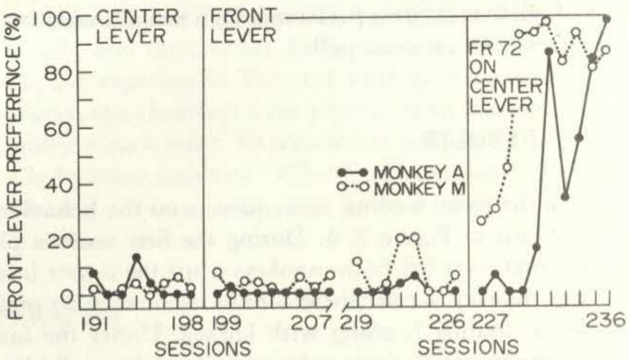

Figure 2-9. Lever preferences of monkeys A and M. From sessions 191–198 the center lever fed the neighboring monkey (as well as the working monkey) while from session 199 on, the front lever fed both monkeys. From sessions 227–236 the fixed ratio (FR) on the center lever was increased from 36 lever presses to 72.

Figure 2-9 shows the effect of the social feeding consequences on the behavior of monkeys A and M. Both pressed mainly the center lever despite our shifting the lever which fed both monkeys from the center lever to the front lever (sessions 199-226). Thus, these monkeys demonstrated a center lever preference which was unchanged by what happened to the neighboring monkey. However, both monkeys readily shifted to the front lever when the fixed ratio on the center lever was doubled in sessions 227-236. These results demonstrated that monkeys A and M were unresponsive to the social feeding consequences despite their sensitivity to the non-social individual variables of reinforcement magnitude and fixed ratio size.

DISCUSSION

In this experiment the four monkeys provided examples of every type of stable reaction to the situation. One monkey (an "altruist") fed the other monkey; one monkey (a "deprivator") avoided feeding the other monkey. The other monkeys ("egocentrics") were not controlled by the social feeding consequences although their lever choice was readily influenced by a non-social variable. This amount of data is sufficient to show that at least three reactions are possible under this experimental treatment. We are impressed by the stubborn fact of monkey S's altruism, but the present experiment provides no information as to the genesis of this behavior. Further analysis of monkey pairs might include investigating the factors of species, sex dominance, early social history, etc. The technique described in this paper should be readily adaptable to the study of such variables.

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3

SOCIAL REINFORCEMENT

The previous chapter examined the reinforcement of one organism by another. The present chapter examines an aspect of that topic: social reinforcement. In social reinforcement, stimuli emitted by one organism reinforce another organism. The study of social reinforcement asks questions such as: What properties of social stimuli make them reinforcing? Do social stimuli need to acquire their ability to reinforce behavior, or are some social stimuli "naturally" reinforcing? Under what circumstances will social stimuli be effective in reinforcing behavior?

Social stimuli have certain physical properties, such as changes in the light patterns reaching the eyes, in the sound waves reaching the ears, and perhaps in the stimuli reaching the skin of the recipient. These changes in themselves can be reinforcing. The phenomenon is known as sensory reinforcement (Kish, 1955; Butler, 1953). Sensory reinforcement can, under some circumstances, confound the social aspect of social reinforcement. For example, in a study by Antonitis and Baron (1964), bar pressing responses of mice were followed by one of several changes in a separate chamber visible to the mouse: illumination of the empty chamber, illumination of the chamber containing a black block, and illumination of the chamber containing an active mouse. The illumination itself was such a strong reinforcer that a comparison of the reinforcing effects of the inanimate and animate stimuli was impossible. The results may be due to the methodology of that experiment. However, sensory reinforcement probably contributes to all reinforcement, including social reinforcement. The importance of this contribution may depend chiefly on the level of sensory deprivation of the organism.

Sensory reinforcement comes very close to being an unconditioned reinforcer. An unconditioned reinforcer is one which increases the probability of occurrence of the behavior it follows, regardless of prior experience. The effect of unconditioned reinforcement is assumed to occur without learning. Food is assumed to be an unconditioned reinforcer, as shock is assumed to be an unconditioned aversive stimulus. Under most circumstances, novel stimuli

will reinforce the behavior of organisms without any apparent conditioning. On the other hand, novel stimuli do not appear to be reinforcing to animals denied a normal social rearing (see Chapter 9 on early social experience). Actually, it has been impossible to "prove" that any reinforcer is unconditioned. The operational definition of "reinforcer" makes such proof unnecessary for its ordinary use in the analysis of behavior. Food is a reinforcer because (and only when) it strengthens the behavior it follows. No assumptions are made about the "pleasantness" or other properties of the food itself. Only its reinforcing effect is generally of concern.

The reinforcing aspects of social stimuli are sometimes regarded as unconditioned reinforcers. Social stimuli are so frequently and powerfully reinforcing that the reinforcement appears unconditioned. On the other hand, it may be more fruitful to regard social stimuli as conditioned, generalized reinforcers. Conditioned reinforcers acquire their reinforcing properties through pairing with what are assumed to be the unconditioned reinforcers. For example, in the standard experimental apparatus, the click that sounds when the food magazine operates becomes reinforcing in itself, because of its pairing with food. The pigeon will, for a time, respond simply to operate an empty food magazine. However, unless food intermittently accompanies the magazine, the behavior will eventually extinguish. Generalized reinforcers are reinforcers which have been paired with a large number of unconditioned, or strong conditioned reinforcers. Money is the most common example of a generalized reinforcer. Money may be used to buy any number of things, and money is a powerful reinforcer of human behavior. Generalized reinforcers such as money are highly resistant to extinction and function quite independently of the unconditioned reinforcers with which they were originally paired. If money were suddenly unnecessary to purchase food, it would still be a reinforcer since it could be used to purchase many other items. Complete elimination of its association with all other reinforcers would be necessary to eliminate a generalized reinforcer. When a country is destroyed, people may use its money to light cigars. However, the tendency of some people to hoard Confederate money long past its usefulness is an indication of the strength and persistence of generalized reinforcers. Also, the miser may hoard money for its own sake, using it as little as possible to buy the items that give it its power.

Those who feel that social stimuli have properties that inanimate stimuli can never have probably also feel that social stimuli are inherently reinforcing. However, the reinforcing effects of social stimuli can vary from individual to individual and from stimulus to stimulus. A history of association with social stimuli is believed necessary for an individual to be susceptible to social reinforcement. The strength and near universality of social reinforcers is probably due to the fact that they are generalized reinforcers. From the time a human being is born, he is surrounded by social stimuli. This class of stimuli is

probably the most prevalent and crucial to the existence of the human organism. The conditions required to produce conditioned social reinforcers are abundant. Social stimuli are associated with innumerable unconditioned and strong conditioned reinforcers such as ingesting food, being relieved of physical distress, and receiving money. Perhaps there are aspects, such as the purely sensory qualities, of social reinforcement which are unconditioned. The conditioned aspects can be separated from the unconditioned aspects only through experimental analysis. Rather than assume that social reinforcement is inborn and unavailable to modification, it is more profitable and consistent with the facts to assume that social reinforcement involves a conditioned reinforcer that acquires its power from the environment. Thus, environmental variables can be sought which will control the reinforcing value of social stimuli. In summary, we view social reinforcers as conditioned, generalized reinforcers which require a history of association with unconditioned reinforcers. Sensory reinforcement is regarded as a relatively unimportant aspect of social reinforcement.

Social stimuli generally do reinforce behavior. They are widely used in everyday experience to control behavior. They are readily available to the person who wishes to reinforce behavior, since he carries these reinforcers with him at all times and presumably has control over their occurrence. Indeed, social reinforcers have been used successfully in many applications of the principles of operant conditioning to human behavior. Social reinforcement has been used to control the behavior of infants (Etzel and Gewirtz, 1967) and school children (Zimmerman and Zimmerman, 1962; Hall, Lund, and Jackson, 1968), to modify behavior disorders (Allyon and Michael, 1959), and to correct behavioral deficits (Wolf, Risley, and Mees, 1964).

The first selection in this chapter, "Effects of adult social reinforcement on child behavior," by F. R. Harris, M. M. Wolf, and D. M. Baer, illustrates the use of social reinforcement in a nursery school setting. It presents several cases of behavior modification using social reinforcement. The method used by Harris, Wolf, and Baer is typical of procedures used to study behavior in nonlaboratory settings. An observer, who does not participate in the experimental procedure itself, records the behavior of the experimenters and subjects. First, a baseline record is made of the initial rate of the behavior to be studied. Then, in the treatment phase, the chosen behavior is reinforced, punished, or extinguished, as the case may be, while its occurrence is again recorded. Next, a procedure designed to reverse the effects of the treatment phase is instituted. In this reversal procedure the behavior that was formerly reinforced is extinguished, or vice versa. Finally, the treatment procedure is reinstituted in the recovery phase. Experiments done in applied settings are plagued with methodological difficulties and uncertainties. However, if a behavior that is reinforced increases during the treatment phase, decreases

during reversal, and again increases when reinforced during recovery, the changes in that behavior are probably due to the experimental conditions. Harris, Wolf, and Baer used this reversal procedure to decrease, reinstate, and finally again decrease excessive crawling, crying, isolate play, and passivity in nursery school children. Social reinforcement was highly effective in controlling these behaviors. The study points up the fact that the attention or solicitude that undesirable behaviors often produce may be a factor in their maintenance. Of course, stimuli other than social ones may contribute to the maintenance of the behaviors, but the elimination of the social reinforcement will usually cause a decrease in the behaviors. It seems natural to attend to a child who is crying, withdrawn, or exhibiting some undesired behavior. Attentive social responses are often reinforced by the child in order to maintain the adult's response. If a child did not stop crying when an adult showed concern, the adult sooner or later would stop showing concern in response to crying. Yet the concern itself increases the probability of a reoccurrence of crying in the future. These cycles of mutual reinforcement are often difficult to break, but a decrease in the undesired behavior is the result.

Harris, Wolf, and Baer point out that the social attention used to reinforce behavior was not, at first, reinforcing for one child. Social stimuli will not always reinforce or punish as the culture assumes they will. Praise and attention are not always reinforcing; scolding and other social stimuli intended to be aversive very often reinforce behavior. This variability in the effectiveness of social stimuli suggests that their values are indeed dependent on the history of the individual.

The second study of social reinforcement presented here occurred in a laboratory setting and provides a methodology that controls some of the uncertainties associated with the study of social reinforcement; the article by D. M. Baer is entitled, "A technique of social reinforcement for the study of child behavior: Behavior avoiding reinforcement withdrawal." By definition, the study of social reinforcement involves the complex and variable social stimuli emitted by individuals. These stimuli are difficult to standardize. In Baer's study, a puppet whose speech is the experimenter's was used to provide social reinforcement for children. Although the verbal behavior of the puppet was not tightly controlled, its movements and expression could be standardized to a degree not possible when using a human reinforcing agent. Many of the reinforcing stimuli were actually mechanical, yet they resembled the stimuli which another human being would emit. The response reinforced was a traditional bar-pressing response. The usual automatic recording apparatus was also used in the experiment.

The social stimuli dispensed by the puppet did reinforce the children's bar pressing. Although the schedule of reinforcement used by Baer is not a

common one, the performances are quite typical of the performances of animals responding to avoid withdrawal of nonsocial reinforcers. There are large individual differences in the effectiveness of the social reinforcers. For one child these reinforcers were very weak, if indeed they were reinforcers at all. For this child, Baer paired an additional, nonsocial reinforcer with the social reinforcers. By presenting the nonsocial with the social reinforcers occasionally, but very rarely, he was able to maintain a good rate of response. Perhaps the rate would have continued if the nonsocial reinforcers were discontinued. Again, the fact that some social reinforcers are ineffective for some individuals points to the importance of the individual's unique past relationships with social stimuli.

In the third study presented, by O. I. Lovaas and co-workers and entitled, "Establishment of social reinforcers in two schizophrenic children on the basis of food," the subjects were two autistic children for whom social stimuli had previously been ineffective. First an attempt was made to condition the word "good" by pairing it with food reinforcement. Since the children did not attend to social stimuli at all, this attempt was unsuccessful. When the social stimuli were made discriminative for food reinforcement, however, they did become conditioned reinforcers. The children were forced to attend to the presence or absence of these reinforcers in order to obtain food. The conditioned social reinforcers were then used, by themselves, to reinforce a bar-pressing response. Although no food ever followed the social reinforcement of bar pressing, the social stimuli did reinforce the response. The social reinforcers were able to maintain a high rate of bar pressing in children for whom they were previously completely neutral stimuli. The results provide an impressive demonstration of what may actually happen when social reinforcers acquire their role in the behavior of ordinary people in everyday life.

Social reinforcers can be ineffective for individuals who lack the personal history of experiences necessary to make them effective. Another area of research in social reinforcement has examined the possibility that satiation could also render them temporarily ineffective. Indeed, if social stimuli are reinforcers, they may function in regard to motivation in a manner similar to the traditional appetitive reinforcers such as food and water. The term motivation is sometimes used in everyday speech as a blanket "explanation" of behavior. "I didn't go because I didn't want to (i.e., wasn't motivated)," or "He's not motivated to learn," and so forth. In the scientific analysis of behavior, motivation refers only to operations that render a reinforcer effective or ineffective. When a pigeon is deprived of food, food will function as a reinforcer. When a pigeon is satiated, food will lose its reinforcing function. The operations of deprivation and satiation are termed motivational.

Do people become "hungry" for social contact, and can they become satiated by too much contact? A number of studies have addressed themselves to that

question (Gewirtz and Baer, 1958; Landau and Gewirtz, 1967; Gewirtz, 1967; Dorwart, *et al.*, 1965; Stevenson and Odom, 1962). Some evidence of social satiation and deprivation effects has been produced. In one study by Gewirtz and Baer (1958), children were reinforced verbally for placing marbles in one of two holes. On the average, verbal reinforcement was more effective for children who had been left alone in a room for 20 minutes before testing than for children who had spent the preceding 20 minutes interacting with the experimenter. In other studies, children who had been reinforced initially at a low rate showed a greater increase in "correct" choices when later reinforced at a higher rate than did children who had been previously given large numbers of reinforcements (Gewirtz, 1967, pp. 22-30). Unfortunately, the results are not clear cut (e.g. Gewirtz, 1967, pp. 30-40). Averaging of results makes interpretation difficult. Gewirtz excluded subjects with obviously abnormal reactions to social reinforcers, yet individual differences could easily have been important. Gewirtz suggests that the effect may be strongest when the reinforcing agent is a woman and the subject is a boy. All in all, some sort of motivational effect does appear to occur in social reinforcers.

Social reinforcement has been demonstrated experimentally to be effective in the control of behavior. Social reinforcers have been shown to acquire reinforcing power through well-known conditioning processes. The social reinforcement relations examined in this chapter also involve successful mutually reinforcing relationships. Social reinforcement can be useful in making social relationships more pleasant, by modifying problem behavior and by correcting behavioral deficits. Furthermore, an understanding of the nature of social reinforcement sheds light on the nature of social stimuli and on social relationships themselves. The studies presented here strongly suggest that social reinforcers are of great importance and usefulness and can be controlled and understood by the methods and concepts heretofore used to control and understand nonsocial reinforcers.

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Effects of adult social reinforcement on child behavior

Florence R. Harris,
Montrose M. Wolf
and
Donald M. Baer

There is a general agreement among educators that one of the primary functions of a nursery school is to foster in each child social behaviors that contribute toward more pleasant and productive living for all. However, there is no similar consensus as to precisely how this objective is to be attained. Many writers subscribe to practices based on a combination of psychoanalytic theory and client-centered therapy principles, usually referred to as a mental hygiene approach. Yet there are considerable variation and vagueness in procedures recommended, particularly those dealing with such problem behaviors as the child's hitting people, breaking valuable things, or withdrawing from both people and things. Read (1955), for example, recommends accepting the child's feelings, verbalizing them for him, and draining them off through vigorous activities. Landreth (1942) advises keeping adult contacts with the child at a minimum based on his needs, backing up verbal suggestions by an implicit assumption that the suggestion will be carried out and, when in doubt, doing nothing unless the child's physical safety is involved. In addition to some of the above precepts, Taylor (1954) counsels parents and teachers to support both desirable and undesirable behaviors and to give non-emotional punishment. According to Standing (1959), Montessori advocates that teachers pursue a process of nonintervention, following careful preparation of a specified environment aimed at "canalizing the energy" and developing "inner command." Nonintervention does not preclude the "minimum dose" of instruction and correction.

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Using some combination of such guidance precepts, teachers have reported success in helping some nursery school children who showed problem behaviors; but sometimes adherence to the same teaching principles has not been helpful in modifying the behavior of concern. Indeed, it is usually not at all clear what conditions and principles may or may not have been operative. All of these precepts have in common the adult behaviors of approaching and attending to a child. Therefore, it seemed to the staff of the Laboratory Preschool at the University of Washington that a first step in developing possible explicit criteria for judging when and when not to attend was to study the precise effects that adult attention can have on some problem behaviors.

This paper presents an account of the procedures and results of five such studies. The two groups of normal nursery school children provided the subjects studied. One group enrolled twelve three-year-olds and the other, sixteen four-year-olds. The two teachers of the younger group and the three teachers of the older group conducted the studies as they carried out their regular teaching duties. The general methodology of these studies was developed in the course of dealing with a particularly pressing problem behavior shown by one child at the beginning of the school year. It is worth considering this case before describing the procedures which evolved from it.

The study dealt with a three-year-old girl who had regressed to an excessive amount of crawling (Harris, Johnston, Kelley, and Wolf, 1964). By "excessive" is meant that after three weeks of school she was spending most of her morning crawling or in a crouched position with her face hidden. The parents reported that for some months the behavior had been occurring whenever they took her to visit or when friends came to their home. The teachers had used the conventional techniques, as outlined above, for building the child's "security."

Observations recorded in the third week at school showed, however, that more than 80% of the child's time was spent in off-feet positions. The records also showed that the crawling behavior frequently drew the attention of teachers. On-feet behaviors, such as standing and walking, which occurred infrequently, seldom drew such notice.

A program was instituted in which the teachers no longer attended to the child whenever she was crawling or crouching, but gave her continuous warm attention as long as she was engaging in behavior in which she was standing, running, or walking. Initially the only upright behaviors that the teachers were able to attend to occurred when the child pulled herself almost to her feet in order to hang up or take down her coat from her locker, and when she pulled herself up to wash her hands in the wash basin. Within a week of the initiation of the new attention-giving procedure, the child acquired a close-to-normal pattern of on-feet behavior.

In order to see whether the change from off- to on-feet behavior was related to the differential attention given by the teachers, they reversed their procedure, making attention once again contingent only upon crawling and

other off-feet behavior. They waited for occasions of such off-feet behavior to "reinforce" with attention, while not attending to any on-feet behavior. By the second day the child had reverted to her old pattern of play and locomotion. The observational records showed the child was off her feet 80% of the class session.

To see whether on-feet behavior could be re-established, the teachers again reversed their procedure, giving attention to the child only when she was engaging in behaviors involving upright positions. On-feet behavior rose markedly during the first session. By the fourth day, the child again spent about 62% of the time on her feet.

Once the child was not spending the greater proportion of her day crawling about, she quickly became a well-integrated member of the group. Evidently she already had well-developed social play skills.

As a result of this demonstration that either walking or crawling could be maintained and that the child's responses depended largely upon the teachers' attending behaviors, the teachers began a series of further experimental analyses of the relationship between teacher attention and nursery school child behavior.

PROCEDURES

A specified set of procedures common to the next studies was followed. First, a child showing problem behavior was selected and records were secured. An observer recorded all of the child's behavior, the environmental conditions under which it occurred, and its immediate consequences under conventional teacher guidance. This was done throughout the $2\frac{1}{2}$-hour school session, daily, and for several days. The records gave detailed pictures of the behavior under study. In each case, it became apparent that the problem behavior almost always succeeded in attracting adult attention.

As soon as these records, technically termed "baseline" records, of the typical behavior of the child and teachers were obtained, teachers instituted a program of systematically giving differential attention to the child. When the undesired behavior occurred, they did not in any way attend to him, but remained absorbed in one of the many necessary activities of teachers with other children or with equipment. If the behavior occurred while a teacher was attending to the child, she at once turned to another child or task in a matter-of-fact and non-rejecting manner. Concurrently, teachers gave immediate attention to other behaviors of the child which were considered to be more desirable than the problem behavior. The net effect of these procedures was that the child could gain a great deal of adult attention if he refrained from engaging in "problem behavior." If under this regime of differential attention the problem behavior diminished to a stable low level at which it was no longer considered a problem, a second procedure was in-

augurated to check out the functional relationship between changes in the child's behavior and the guidance procedures followed.

The second procedure was simply to reverse the first procedure. That is, when the problem behavior occurred, the teacher went immediately to the child and gave him her full, solicitous attention. If the behavior stopped, she turned to the other children and tasks, remaining thus occupied until the behavior recurred. In effect, one sure way for the child to secure adult attention was to exhibit the problem behavior. This procedure was used to secure reasonably reliable information on whether the teachers' special program had indeed brought about the changes noted in the child's behavior. If adult attention was the critical factor in maintaining the behavior, the problem behavior should recur in stable form under these conditions. If it did so, this was evidence that adult attention was, technically speaking, a positive social reinforcer for the child's behavior.

The final stage of the study was, of course, to return to procedures in which attention was given at once and continuously for behaviors considered desirable. Concurrently, adult attention was again withheld or withdrawn as an immediate consequence of the problem behavior. As the problem disappeared and appropriate behaviors increased, the intense program of differential adult attention was gradually diminished until the child was receiving attention at times and in amounts normal for the teachers in the group. However, attention was given only on occasions of desirable behavior, and never (or very seldom) for the undesirable behavior.

CRYING AND WHINING

Following the above procedures, a study was conducted on a four-year-old boy who cried a great deal after mild frustrations (Hart, Allen, Buell, Harris, and Wolf, 1964). This child averaged about eight full-fledged crying episodes each school morning. The baseline observations showed that this crying behavior consistently brought attention from the teachers, in the form of going to him and showing solicitous concern. During the following days, this behavior was simply ignored. (The only exceptions to this were to have been incidents in which the child had hurt himself considerably and was judged to have genuine grounds for crying. Naturally, his hurts were to be attended to. Such incidents, however, did not occur.) Ten days of ignoring the outcries, but giving approving attention for verbal and self-help behaviors, produced a steady weakening of the crying response to a nearly zero level. In the final five days of the interval, only one crying response was recorded. The number of crying episodes on successive days is graphed in cumulative form in Figure 3-1.

During the next ten days, crying was again reinforced whenever it occurred, the teachers attending to the boy on these occasions without fail.

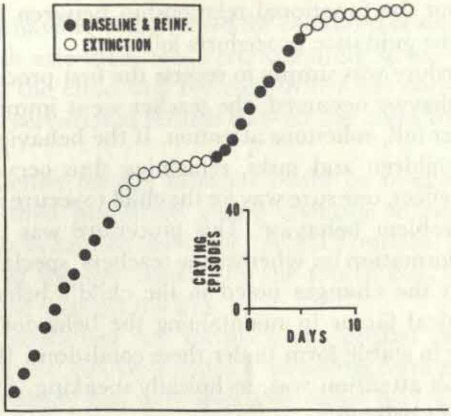

Figure 3-1. Cumulative record of the daily number of crying episodes.

At first, it was necessary to give attention for mere grimaces that might follow a bump. The daily crying episodes quickly rose to a rate almost as high as formerly. A second ten-day period of ignoring the outcries again produced a quick weakening of the response to a near-zero level, as is apparent in the figure. Crying remained at this low level thereafter, according to the informal judgment of the teachers.

The same procedures were used in another study of "operant crying" of a four-year-old boy, with the same general results.

ISOLATE PLAY

Two studies involved children who exhibited markedly solitary play behavior. Extremely little of their morning at nursery school was spent in any interaction with other children. Instead, these children typically played alone in a quiet area of the school room or the play yard, or interacted only with the teachers. For present purposes, both of these response patterns will be called "isolate play." Systematic observation showed that isolate play usually attracted or maintained the attention of a teacher, whereas social play with other children did so comparatively seldom.

A plan was initiated in which the teacher was to attend regularly if the child approached other children and interacted with them. On the other hand, the teacher was not to attend to the child so long as he engaged in solitary play. To begin with, attention was given when the child merely stood nearby, watching other children; then, when he played beside another child; and finally, only when he interacted with the other child. Teachers had to take special precautions that their attending behaviors did not result in drawing the child away from children and into interaction solely with the teacher.

Two techniques were found particularly effective. The teacher directed her looks and comments to the other child or children, including the subject only as a participant in the play project. For example, "That's a big building you three boys are making; Bill and Tom and Jim (subject) are all working hard." Accessory materials were also kept at hand so that the teacher could bring a relevant item for the subject to add to the play: "Here's another plate for your tea party, Ann." In both isolate cases this new routine for giving adult attention produced the desired result: Isolate play declined markedly in strength while social play increased two- or three-fold.

After about a week of the above procedure, the consequences of non-isolate and isolate play were reversed. The teachers no longer attended to the child's interactions with other children, but instead gave continuous attention to the child when he was alone. Within a week, or less, isolate play became the dominant form of activity in both cases.

The former contingencies were then reinstated: The teachers attended to social interactions by the child, and ignored isolate play as completely as they could. Again, isolate play declined sharply while social interaction increased as before. The results of one of these studies (Allen, Hart, Buell, Harris, and Wolf, 1964) are summarized in Figure 3-2.

Figure 3-2 shows the changes in behavior of a 4½-year-old girl under the different guidance conditions. The graph shows the percentage of play time that she spent in interaction with other children and the percentage of time spent with an adult. The remainder of her time was spent alone. It is apparent that only about 15% of this child's play time was spent in social play as long

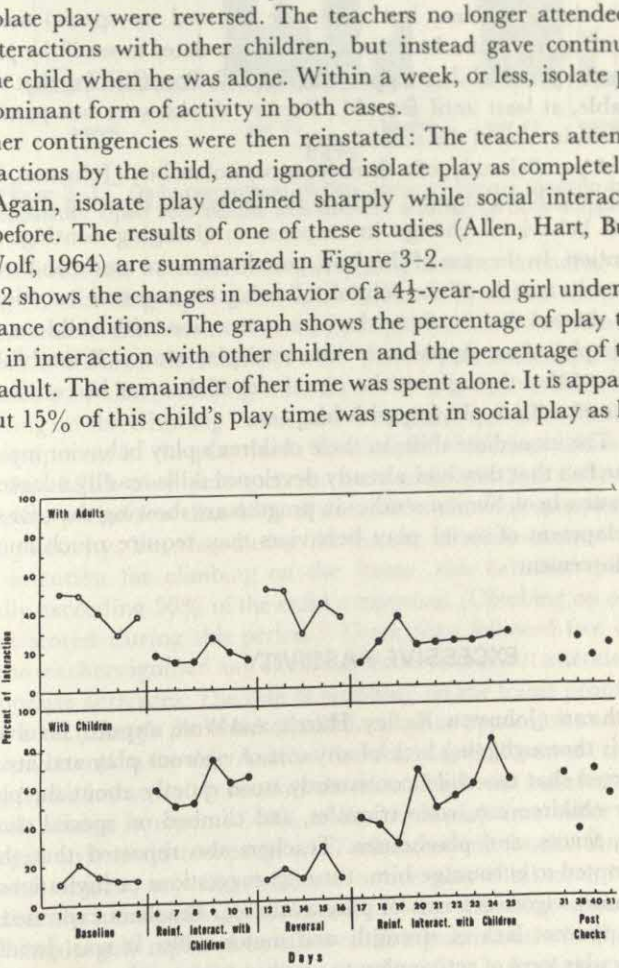

Figure 3-2. Daily percentages of time spent in social interaction with adults and with children during approximately two hours of each morning session.

as the teachers attended primarily to her solitary play. But interacting behaviors rose to about 60% of total play time when the teachers attended only to her social play. At the same time, her interactions solely with teachers, not being reinforced, fell from their usual 40% of the child's playtime to about 20%. These were considered reasonable percentages for this nursery school child. During Days 17 through 25 the schedule of adult reinforcement of social play was gradually reduced to the usual amount of attention, given at the usual irregular intervals. Nevertheless, the social behavior maintained its strength, evidently becoming largely self-maintaining.

After Day 25, the teachers took care not to attend too often to the child when she was alone, but otherwise planned no special contingencies for attending. Four checks were made at later dates to see if the pattern of social behavior persisted. It is apparent (Fig. 3-2, Post Checks) that the change was durable, at least until Day 51. Further checks were not possible because of the termination of the school year.

A parallel study, of a three-year-old isolate boy (Johnston, Kelley, Harris, Wolf, and Baer, unpub.) yielded similar results showing the same pattern of rapid behavioral change in response to changing contingencies for adult attention. In the case of this boy, postchecks were made on three days during the early months of the school following the summer vacation period. The data showed that on those days his interaction with children averaged 55% of his play time. Apparently his social play was well established. Teachers reported that throughout the remainder of the year he continued to develop ease and skills in playing with his peers.

The immediate shifts in these children's play behavior may be partly due to the fact that they had already developed skills readily adapted to play with peers at school. Similar studies in progress are showing that, for some children, development of social play behaviors may require much longer periods of reinforcement.

EXCESSIVE PASSIVITY

A fifth case (Johnston, Kelley, Harris, and Wolf, unpub.) involved a boy noted for his thoroughgoing lack of any sort of vigorous play activity. The teachers reported that this child consistently stood quietly about the play yard while other children ran, rode tricycles, and climbed on special climbing frames, trees, fences, and playhouses. Teachers also reported that they frequently attempted to encourage him, through suggestions or invitations, to engage in the more vigorous forms of play available. Teachers expressed concern over his apparent lack of strength and motor skills. It was decided to select a particular form of active play to attempt to strengthen. A wooden frame with ladders and platforms, called a climbing frame, was chosen as the vehicle for establishing this activity. The teachers attended at first to the child's mere

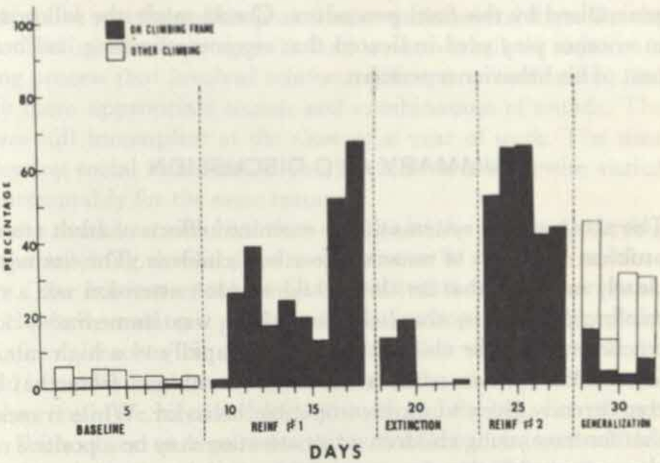

Figure 3–3. Daily percentages of time spent in using a climbing-frame apparatus. Open bars indicate time spent in climbing on other equipment.

proximity to the frame. As he came closer, they progressed to attending only to his touching it, climbing up a little, and finally to extensive climbing. Technically, this was reinforcement of successive approximations to climbing behavior. Figure 3–3 shows the results of nine days of this procedure, compared to a baseline of the preceding nine days. In this figure, black bars represent climbing on the climbing frame, and white bars represent climbing on any other equipment in the play yard. The height of the bars shows the percentage of the child's play time spent in such activities. It is clear that during the baseline period less than 10% of the child's time was spent in any sort of climbing activity, but that during the course of reinforcement with pleased adult attention for climbing on the frame, this behavior greatly increased, finally exceeding 50% of the child's morning. (Climbing on other objects was not scored during this period.) There then followed five days during which the teachers ignored any climbing on the frame, but attended to all other appropriate activities. The rate of climbing on the frame promptly fell virtually to zero, though the child climbed on other apparatus and was consistently given attention for this. Another five days of reinforcement of use of the climbing frame immediately restored the climbing-frame behavior to a high stable level, always in excess of 40% of the boy's play time. After this, the teachers began an intermittent program of reinforcement for climbing on any other suitable objects, as well as vigorous active play of all sorts, in an effort to generalize the increased vigorous activity. Frame-climbing weakened considerably, being largely replaced by other climbing activities, which were now scored again as data. Activities such as tricycle-riding and running were not systematically recorded due to difficulties in reliably scoring them. It is clear from the data obtained, however, that climbing activities were thoroughly

generalized by this final procedure. Checks made the following school year in another play yard indicated that vigorous climbing had become a stable part of his behavior repertoire.

SUMMARY AND DISCUSSION

The above studies systematically examined effects of adult attention on some problem behaviors of normal pre-school children. The findings in each case clearly indicated that for these children adult attention was a strong positive reinforcer. That is, the behavior which was immediately followed by a teacher's giving the child attention rose rapidly to a high rate, and the rate fell markedly when adult attention was withheld from that behavior and concurrently given to an incompatible behavior. While it seems reasonable that for most young children adult attention may be a positive reinforcer, it is also conceivable that for some children adult attention may be a negative reinforcer. That is, the rate of a behavior may decrease when it is immediately followed by the attention of an adult, and rise again as soon as the adult withdraws. Actually, for a few children observed at the preschool, it has been thought that adult attention was a negative reinforcer. This seemed to be true, for instance, in the case of the climbing-frame child. Before the study was initiated, the teachers spent several weeks attempting to make themselves positively reinforcing to the child. This they did by staying at a little distance from him and avoiding attending directly to him until he came to them for something. At first, his approaches were only for routine help, such as buttoning his coat. On each of these occasions they took care to be smilingly friendly and helpful. In time, he began making approaches of other kinds, for instance, to show a toy. Finally, when a teacher approached him and commented with interest on what he was doing, he continued his play instead of stopping, hitting out, or running off. However, since his play remained lethargic and sedentary, it was decided that special measures were necessary to help him progress more rapidly. It was the use and effects of these special measures that constituted the study. Clearly, however, adult attention must be or become positively reinforcing to a child before it can be successfully used to help him achieve more desirably effective behaviors.

Studies such as those reported here seem to imply that teachers may help many children rapidly through systematic programming of their adult social reinforcements. However, further research in this area seems necessary. Some of our own studies now in progress suggest that guidance on the basis of reinforcement principles may perhaps bring rapidly into use only behaviors which are already available within the repertory of the child. If the desired behavior requires skills not yet in the child's repertory, then the process of developing those skills from such behaviors as the child has may require weeks or months. For example, a four-year-old child who could verbalize but

who very rarely spoke was helped to speak freely within several days. On the other hand, a child of the same age who had never verbalized required a lengthy shaping process that involved reinforcing first any vocalization, and then gradually more appropriate sounds and combinations of sounds. The latter study was still incomplete at the close of a year of work. The time required to develop social behaviors in isolate children has likewise varied considerably, presumably for the same reasons.

Although the teachers conducted these studies in the course of carrying out their regular teaching duties, personnel in excess of the usual number were necessary. The laboratory school was staffed with one teacher to no more than six children, making it possible to assign to one teacher the role of principal "reinforcer teacher" in a study. This teacher was responsible for giving the child immediate attention whenever he behaved in specified ways. In addition, observers were hired and trained to record the behavior of each child studied. Each observer kept a record in ten-second intervals of his subject's behavior throughout each morning at school. Only with such staffing could reinforcement contingencies be precisely and consistently administered and their effects recorded.

Unless the effects are recorded, it is easy to make incorrect judgments about them. Two instances illustrate such fallibility. A boy in the laboratory preschool frequently pinched adults. Attempts by the teachers to ignore the behavior proved ineffective, since the pinches were hard enough to produce at least an involuntary startle. Teachers next decided to try to develop a substitute behavior. They selected patting as a logical substitute. Whenever the child reached toward a teacher, she attempted to forestall a pinch by saying, "Pat, Davey," sometimes adding, "Not pinch," and then strongly approving his patting, when it occurred. Patting behavior increased rapidly to a high level. The teachers agreed that they had indeed succeeded in reducing the pinching behavior through substituting patting. Then they were shown the recorded data. It showed clearly that although patting behavior was indeed high, pinching behavior continued at the previous level. Apparently, the teachers were so focused on the rise in patting behavior that, without the objective data, they would have erroneously concluded that development of a substitute behavior was in this case a successful technique. A second example illustrates a different, but equally undesirable, kind of erroneous assumption. A preschool child who had to wear glasses (Wolf, Risley, and Mees, 1964) developed a pattern of throwing them two or three times per day. Since this proved expensive, it was decided that the attendants should put him in his room for ten minutes following each glasses-throw. When the attendants were asked a few days later how the procedure was working, they said that the glasses-throwing had not diminished at all. A check of the records, however, showed that there was actually a marked decrease. The throwing dropped to zero within five days. Presumably, the additional effort involved in carrying out the procedure had given the

attendants an exaggerated impression of the rate of the behavior. Recorded data, therefore, seem essential to accurate objective assessments of what has occurred.

The findings in the studies presented here accord generally with results of laboratory research on social development reviewed in this journal by Horowitz (1963). The importance of social reinforcement was also noted by Bandura (1963) in his investigations of imitation. Gallwey (1964) has replicated the study of an isolate child discussed here, with results "clearly confirmatory of the effectiveness of the technique." Further studies in school situations that can combine the function of research with that of service seem highly desirable.

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A technique of social reinforcement for the study of child behavior:
Behavior avoiding reinforcement withdrawal

Donald M. Baer

The principle of social reinforcement has seen increasing application recently to the social development of the child. Despite the central character of this concept in learning approaches to child development, there is relatively little laboratory research dealing with it. Studies such as those by Gewirtz and Baer (3, 4), Lovaas (5), Zigler *et al.* (8), and Terrell and Kennedy (7) have made explicit use of social reinforcement in a controlled manner. However, most studies involving social stimuli use them as implicit rather than controlled factors in the situation. And few if any investigations emphasize one of the basic characteristics of social reinforcement: the variation in effectiveness such stimuli should show for individual children, which simultaneously reflects their differing histories of social conditioning and, to a significant degree, describes their present personality traits.

This report describes a possible method for investigating in some breadth the process of social reinforcement of children's behaviors. It also presents preliminary data on individual differences in the responsiveness of children to a specific social reinforcer.

The basic feature of this method is the use of a mechanized talking puppet instead of a human to present social reinforcers to the child. There are two reasons for this. The first is the obvious ease of standardizing a puppet's behavior in delivering or withdrawing social reinforcers such as attention and approval. No inadvertent smiles, glances, or raised eyebrows will be provoked from a mechanized puppet. These responses are quite likely to emerge from even a well-trained adult interacting with small children and can provide important uncontrollable social reinforcement for the child's behavior. The second reason is less definite but equally important. It seems reasonable that a puppet would provide less generalization from the threatening stimulus aspects probably involved in interactions with any adult only moderately

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familiar to the child. To the extent that this presumption is sound, then an interaction between child and puppet based upon the social stimuli the puppet can offer could be profitably less complex and variable than a corresponding interaction between child and adult.

The specific purpose of this study is to show that a mechanized talking puppet can serve as an effective source of attention for preschool children, so that behaviors which avoid the loss of the puppet's attention increase in strength (cf. Baer [1, 2] for previous work with this contingency). Furthermore, it will be asked whether the subjects' behaviors for the puppet's attention correspond in strength with their typical behaviors for attention in the nursery school setting.

PROCEDURE

Apparatus

The apparatus is a cowboy puppet seated in a chair on a puppet stage. This is pictured in Figure 3-4. The puppet (manufactured by the Hazelle Company, Kansas City) has articulated arm, leg, and neck joints and a movable jaw which allows a reasonably realistic portrayal of speech when the experimenter's voice is piped through the puppet. The string operating the jaw is connected to a concealed electric motor which is operated by the experimenter (E). The puppet's right hand rests upon a miniature bar-pressing apparatus placed on a small table beside the puppet's chair. This bar-pressing apparatus is a close replica of the child's bar which is located near the child's

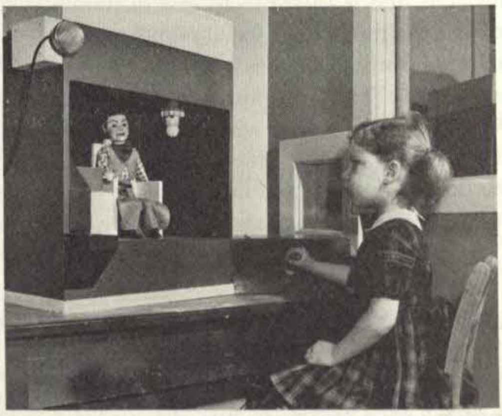

Figure 3-4. The mechanized puppet in an "attentive" position.

right hand. A solenoid concealed within the puppet stage is connected to the puppet's bar by a string, such that the bar may be depressed remotely by *E* at any time. Since the puppet's right hand rests freely upon the bar, he appears to be pressing it. The puppet's head, unless held up by its strings, rests with chin on chest, such that he seems to be looking into his lap. A second concealed motor is connected to the head strings, and at *E*'s option can lift the head into a position in which the puppet is looking directly at the child seated before him. Neither the left arm nor either of the legs is connected to any motor or solenoid; these limbs simply rest in place.

On the ceiling of the stage is a small 7½-w. white light bulb. This may be used as a cue for various events of the experimental design. Otherwise it can be on to serve as a soft light source for the puppet stage. High on the puppet's right is a microphone which connects to *E*'s earphones and to a tape recorder. This microphone picks up both the puppet's and the child's speech. Also on the puppet's right, but inside the stage, is a chute and tray for delivering trinkets and other small reinforcers to the child. The tray can be seen in Figure 3-4 projecting out from the stage. The dispenser which produces these material reinforcers is concealed in the upper part of the puppet stage.

A 4-in. loudspeaker is mounted on the back of the puppet's chair, completely out of the child's sight. The puppet's voice (i.e., *E*'s voice) comes to the child from this speaker while the jaw is worked in synchronization by *E*.

In this study, attention was defined as the raising of the puppet's head from its resting position, immediately followed by speech from the puppet (unless the child was talking, in which case the puppet "listened"). The withdrawal of attention was accomplished by immediate cessation of speech and a simultaneous drop of the head into its inattentive position. When the child did not talk, the puppet (when attentive) engaged in a standard conversation with the child. It consisted of introductions, questions about what the child had been doing in nursery school just before, answering the virtually inevitable questions about the cowboy's acquaintance with various TV cowboy characters (he knew them all); describing his horse and where it was (back at the ranch); and recounting a rambling story of his adventures while out riding the other day. With many children, the puppet never reached this last stage of his conversation, since they would begin to lead the talk to topics of their own. In this case the puppet listened, responding with short remarks designed mainly to allow the child to continue as long as he would. When the child paused for more than about 15 sec., the puppet would return to his standard conversation with "Well, as I was saying, I . . . ."

This study used the stage light as a cue or discriminative stimulus for attention. While the light was on, the puppet would be attentive, either listening or talking. When the light went off the first time, the puppet would say, "Whoops! There goes my light. I can only talk to you when that light's on." He would then drop his head and say no more. Subsequent turning on

of the light, and keeping it on, depended upon the child's bar-pressing responses, according to an "escalator" schedule of reinforcement-withdrawal (described in a later section). From then on, whenever the light went off, the puppet immediately dropped his head and stopped talking, even in mid-sentence, if he was talking at the time (attention withdrawal). If the child turned the light on by a bar-pressing response, the puppet immediately raised his head, and, if the child said nothing, the puppet resumed the conversation (attention presentation).

Sequence of Procedures

All Ss were dealt with by an adult female assistant (*A*). She was a familiar person to all of the nursery school children, known to them for several months prior to the experiment. Each child was approached by *A* initially and asked if he wanted to come to the playroom and see a puppet. If the child declined, *A* said, "You can come later," and asked another child. (Eventually, almost all children from the group accepted.) When *A* and the child entered the laboratory playroom, *A* pointed to the puppet, saying, "There he is," and escorted the child to a chair placed in front of the puppet stage (which was so placed that both child and puppet were visible to *E* through a one-way mirror, seen in Figure 3-4 directly behind the child's head). The stage light was off and the puppet was not attentive. *A* then withdrew to a chair behind a partition in a corner of the playroom saying, "I'll sit back here while you talk to the puppet." As she retired to her corner, the stage light was turned on and the puppet's head rose to the attending position; the puppet said, "Hi!" and the standard conversation was started.

A session was considered to be about 20 min. of conversation between *S* and the puppet. However, any session was allowed to end whenever *S* insisted upon leaving, as evidenced by getting up from his chair and going to *A* with a request to leave. After 20 min. of conversation, the puppet ended the session during a natural break in the conversation by saying, "Well, that's about all I've got time for today. Want to come see me again?" (*Ss*—even shy ones—invariably say "Yes" or nod affirmatively. However, one *S* was induced to return for her second and third sessions only with difficulty.) Each *S* was seen for three sessions, spaced three to four days apart.

If a session was ended by *S* approaching *A* with a request to leave, the experimenter instructed *A* to agree and to return the child to the nursery school. (*A* wore a small earphone and could be instructed by *E* at any time without *S* overhearing.) If the puppet ended the session, he then called out loudly, "Miss ———, will you take (child's name) back to his (her) friends?" If *S* wanted to leave to go to the bathroom, *A* took him and returned him if he was willing, and the session was resumed.

Reinforcement schedule

The puppet's attention was maintained or withdrawn according to an "escalator" schedule of reinforcement withdrawal (6). In this schedule the effect of every response is to add 3 sec. to the interval between that response and the next withdrawal of reinforcement. Thus, once the puppet's attention has been withdrawn, a response will re-present it for 3 sec., after which it will be withdrawn again, until another response is made. Given another response, attention will again be presented for 3 sec. But if still another response is made before the 3 sec. have passed, an additional 3 sec. are added to the interval between that response and the next withdrawal. For example, if this response occurred after 2 of the 3 sec. had passed, then it would be 4 sec. until the next withdrawal: 1 sec. remaining from the previous interval plus 3 sec., gained by the response. Had 10 responses been made, each would have contributed 3 sec. for a total of 30 sec. gained. This schedule was used by the author in a previous study in which movie cartoons were withdrawn (1) and proved efficient in generating behaviors in many children which successfully avoided most of the reinforcement withdrawals.

This schedule was put into effect after the first 5 min. of the first session. During the first 5 min. the puppet was attentive, the stage light was on, and the standard conversation was carried as far as the child's verbal responses would allow. On the subsequent two sessions, the child found the puppet attentive only for the first 30 sec. of the session; after that time the light went off, the puppet's attention was withdrawn, and the escalator schedule was in effect.

Subjects

Sixteen preschool children between the ages of 4 and 5 served as subjects. These were enrolled at the University of Washington Nursery School and represent upper middle social class backgrounds and better than average intelligence levels.

Five of the 16 children were chosen by two nursery school teachers as displaying a wide range of attention-seeking behavior in the nursery school setting. The first subject (*S*1, a boy) was described as constantly seeking attention, whether approving or disapproving, becoming very excited when getting it. *S*2 (a girl) was described as seeking approving or disapproving attention almost as constantly, but showing less excitement about it. *S*3 (a boy) was described as "just average." *S*4 (a boy) was said to seek attention rarely, and only when it was combined with approval. *S*5 (a girl) was labeled as very shy, typically avoiding attention whether it was mixed with approval or not.

The experimenter ran the *S*s in ignorance of who had been rated and who had not and of what the actual descriptions were. Subsequent to the study, the critical five *S*s were identified by the nursery school teachers.

RESULTS AND DISCUSSION

The bar-pressing responses of each *S* were recorded on a cumulative recorder. This method of recording was selected for several reasons: (a) All of the data of each *S* are preserved for inspection and analysis. (b) Examination of the cumulative response curves gives a complete picture of the developing avoidance behavior of each *S* at every stage of the learning process. (c) It is possible at any point to correlate changes in the response rate and distribution with the reinforcement withdrawals and re-presentations which may control it. (d) It is easy to make a visual comparison of any *S* with any other *S*.

Figure 3-5 is a magnification of a (hypothetical) cumulative response curve in which the significant events and patterns are labeled. Inspection of this figure may clarify the data presented in Figure 3-6.

The cumulative response curves of the five *S*s selected as a spectrum of attention-seeking behavior in a nursery school setting are shown in Figure 3-6. It will be recalled that *S*1 was rated as most attention-seeking, *S*2 as less, etc. The data of each of *S*'s three sessions are shown as a separate curve, the first on the left of the figure, the third on the right. (Only the first two sessions of *S*5

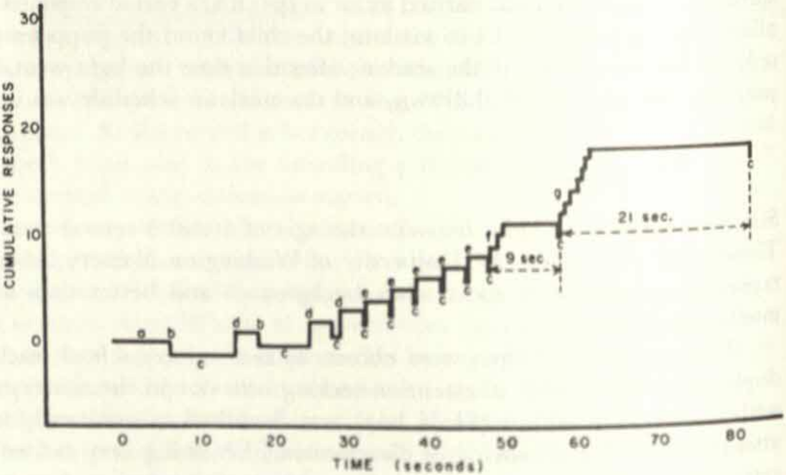

Figure 3-5. A magnified specimen of a hypothetical cumulative response curve.
(*a*) Puppet's attention is maintained until *b*.
(*b*) Attention is withdrawn.
(*c*) Attention remains withdrawn until the next response (*d*, *e*, *f*, or *g*).
(*d*) Response is made and attention is re-presented for 3 sec.
(*e*) Response is made *immediately* following withdrawal and attention is re-presented for 3 sec.
(*f*) Three responses are made and attention is re-presented for 3 × 3 sec. or 9 sec.
(*g*) Seven responses are made and attention is re-presented for 7 × 3 sec. or 21 sec.

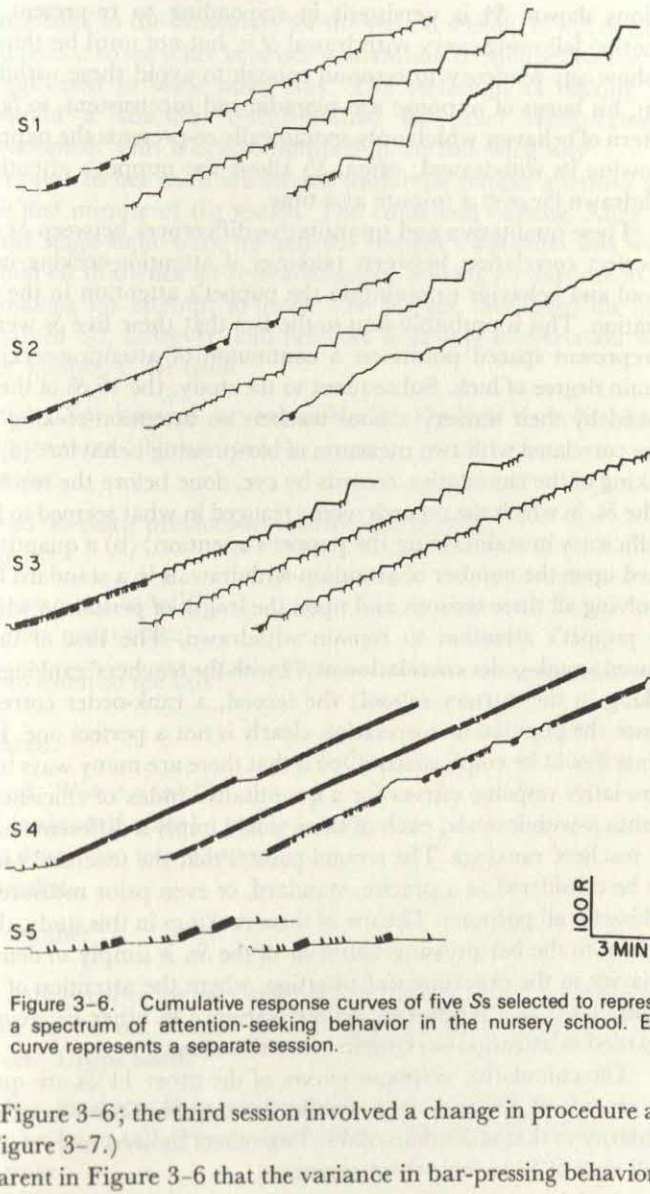

Figure 3-6. Cumulative response curves of five *S*s selected to represent a spectrum of attention-seeking behavior in the nursery school. Each curve represents a separate session.

are shown in Figure 3-6; the third session involved a change in procedure and is shown in Figure 3-7.)

It is apparent in Figure 3-6 that the variance in bar-pressing behavior to present and maintain the puppet's attention is largely accounted for by the rankings of these children on their attention-seeking behaviors in the nursery school setting. *S*1 and *S*2 are relatively quick to develop a pattern of response which avoids withdrawals of the puppet's attention. *S*3 shows a pattern of response which follows the same trend, but does not progress so far in maintaining the puppet's attention for long periods of time, during the three

sessions shown. *S*4 is persistent in responding to re-present the puppet's attention following every withdrawal of it, but not until his third session does he show any tendency to respond enough to avoid these withdrawals. Even then, his bursts of response are sporadic and inconsistent, so far. *S*5 shows a pattern of behavior which only sporadically re-presents the puppet's attention following its withdrawal; often, *S*5 allows the puppet's attention to remain withdrawn for over a minute at a time.

These qualitative and quantitative differences between *S*s seem to show a perfect correlation between rankings of attention-seeking in the nursery school and behavior to maintain the puppet's attention in the experimental situation. This is probably due to the fact that these five *S*s were preselected to represent spaced points on a continuum of attention-seeking, and to a certain degree of luck. Subsequent to the study, the 16 *S*s of the sample were ranked by their nursery school teachers on attention-seeking. These ranks were correlated with two measures of bar-pressing behavior: (a) a qualitative ranking of the cumulative records by eye, done before the teachers' rankings of the *S*s, in which the records were arranged in what seemed to be their order of efficiency in maintaining the puppet's attention; (b) a quantitative ranking based upon the number of attention-withdrawals in a standard length of time involving all three sessions and upon the length of periods in which *S* allowed the puppet's attention to remain withdrawn. The first of these measures showed a rank-order correlation of .72 with the teachers' rankings of attention-seeking in the nursery school; the second, a rank-order correlation of .67. Hence the population correlation clearly is not a perfect one. However, two points should be emphasized. One is that there are many ways to examine the cumulative response curves for a quantitative index of efficiency in avoiding attention-withdrawals; each of these would imply a different correlation with the teachers' rankings. The second point is that the teachers' rankings should not be considered as a precise, standard, or even prior measure of attention-seeking for all purposes. The use of these rankings in this study, the correlation of them to the bar-pressing behavior of the *S*s, is simply to demonstrate that behavior in the experimental situation, where the attention of the puppet is manipulated as a reinforcer, reflects variance in other behaviors commonly regarded as attention-seeking in other situations.

The cumulative response curves of the other 11 *S*s are quite similar to the records of *S*3, and, to a smaller extent, *S*4. One record showed more similarity to that of *S*5 than of *S*4. Two others showed more similarity to that of *S*2 than of *S*3 in their third sessions.

FURTHER PROCEDURE AND RESULTS

The record of *S*5 shows little behavior to present the puppet's attention, and virtually none to avoid further withdrawals of it. Furthermore, *S*5 was

difficult to entice back to the laboratory for the second session. It was decided to use her third session to see if her behavior to maintain the puppet's attention could be strengthened in some other way. The technique of making the puppet's attention a stimulus discriminative for other reinforcements (trinkets) was adopted. This was accomplished in the following way:

The child came to her third session and found the puppet attentive and talking for the first minute of the session. The child said nothing. After the first minute, the stage light went off and the puppet's attention was withdrawn. The child sat in silence for several minutes, making no response to the bar but also making no attempt to leave. The puppet then lifted his head (the light remained off, however) and held the following conversation with the child (P for puppet, C for child):

1. P: Lifts head. "You know, I can only talk when the light is on. You know how to turn it on." Drops head.
   C: No response.
2. P: Lifts head. Repeats previous statements, drops head.
   C: No response.
3. P: "Don't you want to talk?"
   C: "No" (very quiet voice).
4. P: "Want to listen to me talk?"
   C: Nods.
   P: Drops head.
5. P: Lifts head. "Want a toy?"
   C: "Yes!" (animated voice)
   P: Trinket drops into tray on stage.
   C: Takes trinket.
6. P: "Want another?"
   C: "Yes!"
   P: "I can only get toys for you when we're talking, and I can only talk when the light is on. I really shouldn't be talking to you now." (The light is off.) Drops head.
7. C: Presses bar, produces light and puppet's attention for 3 sec.
   P: "Well, now I can talk. Here's another toy." Trinket drops into tray.
   C: Takes trinket.
   P: At end of 3 sec. drops head.
   C: Waits nearly 1 min., then . . .
8. C: Presses bar, produces light and puppet's attention for 3 sec.
   P: "I can talk again! Well! Here's another toy for you." Trinket drops into tray.
   C: Takes it.

P: "Say, did I ever—" Interrupted by end of 3-sec. interval.
C: Waits more than 1 min., then . . .

9. C: Presses bar, produces light and puppet's attention for 3 sec.
P: "Did I ever tell you about the last time I was out riding? Say, here's another toy." Trinket drops into tray.
C: Takes it.
P: "I was riding the other day and—" Interrupted by end of 3-sec. interval.
C: Waits about 2 min. before next bar-pressing response.

At this point the record speaks for itself, as shown in Figure 3-7. The numbers marking the points in the conversation are shown in Figure 3-7 at the times when they occurred. The delivery of a trinket is indicated by the symbol ∧. Otherwise the record is read as before. *S*5 now shows a persistent response of re-presenting the puppet's attention almost immediately following its withdrawal and soon breaks into a response pattern which maintains the puppet's attention perfectly until the end of the session. Trinkets are given at increasing intervals. As long as the stage light is on, the puppet talks consistently, working through his standard conversation. At the point marked 10 in Figure 3-7, the puppet said, "How many toys do you have now?" The child replied, "Fifteen" after counting them. The puppet then said, "That's a lot. I guess that's all for today. You can have more next time you come." The child then stopped pressing the bar until the time "saved" ran out. When the puppet's attention was withdrawn (the point marked 11 in Figure 3-7), she got up and asked *A* to leave.

It seems then that, for *S*5, the puppet's attention can be made a reinforcing stimulus which will support extensive bar-pressing which avoids its withdrawal, *if* it is discriminative for other, more powerful, reinforcers (trinkets). When this discriminative status of the puppet's attention is removed by his final remarks, bar-pressing to maintain his attention stops abruptly.

The functional role of the stage light is of some relevance here. Pilot work showed that if bar-pressing had no effect on the puppet's attention, whether he was attentive or inattentive, but instead only produced or maintained the stage light, then very little behavior could be produced in any *S* on this basis alone. If the stage light is not used as an "excuse" by the puppet for withdrawing his attention, then bar-pressing behavior still develops in most *S*s to produce and maintain his attention, but there is more hesitancy in the first session about responding. For some children, the puppet's first withdrawal of attention without such an "excuse" leads the child to get up and start for the door, as if the session were now over. If the child is brought back with some remark indicating that the puppet might talk some more, then behavior develops much as it does with the use of the stage light as an "excuse," as

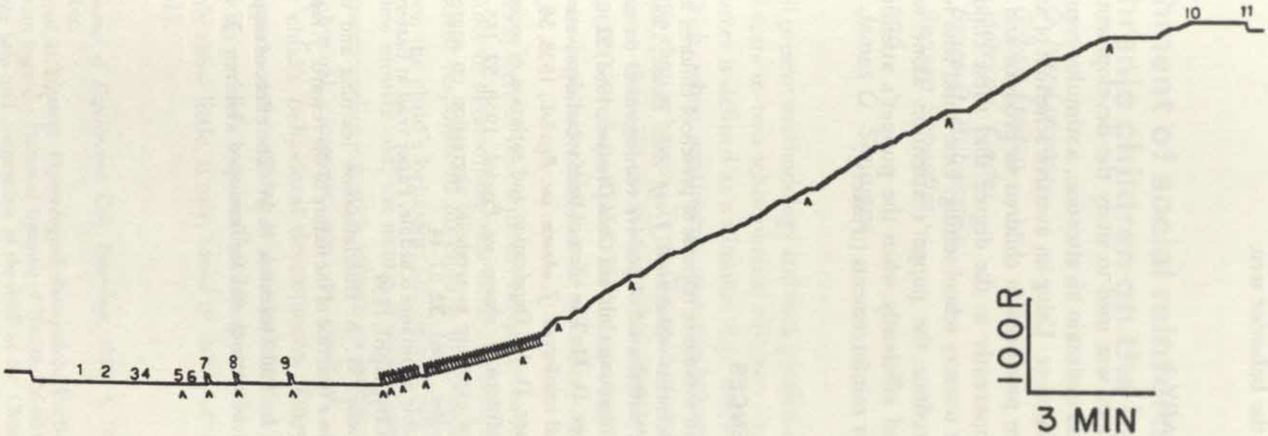

Figure 3–7. Cumulative response curve of the third session of *S*5.

shown in Figure 3-6. Hence the light serves as a useful cue in this context, but does not itself support the behavior seen.

SUMMARY

A talking cowboy puppet was used to study the development of children's behavior to produce and maintain his attention, a stimulus event which could function as a social reinforcer. Using an aversive schedule of attention withdrawal, behaviors were produced in children to produce and maintain the puppet's attention, apparently to the degree that these children typically sought attention in the nursery school setting. One child who would respond only minimally to produce the puppet's attention alone was caused to respond vigorously and efficiently when the puppet's attention was made discriminative for other reinforcements (trinkets).

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Establishment of social reinforcers in two schizophrenic children on the basis of food

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This paper will present methodology and data pertaining to the establishment of social reinforcers in two schizophrenic children characterized as autistic. A social reinforcer is defined as a stimulus (e.g., the word "good") given by one person which, when contingent upon the behavior of another person, serves to modify that behavior. Typically, such stimuli have acquired their reinforcing power through association with already powerful reinforcers, such as food and the relief of pain. Hence, a social reinforcer can also be designated as an acquired reinforcer (a secondary, conditioned, or learned reinforcer).

It is generally agreed that a parent's response to his child's behavior is of major significance in determining that child's development. One of the ways in which a parent responds to his child is to present and remove stimuli, contingent upon the child's behavior, i.e., he will reward and punish. After the child is a few months old, the nature of these stimuli is largely acquired. That is, the parent relies on such stimuli as smiles, verbal approval and disapproval, physical closeness, etc., to establish, refine, and maintain aspects of his child's behavioral development. To affect the child, these stimuli must *acquire* some meaning or stimulus function for him. A child who is not affected by his parent's approval and disapproval will behave abnormally, and conceivably show little, if any, social or intellectual development (Bijou and Baer, 1961).

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Several authors on autism have argued that the failure of autistic children to develop normally is based on their failure to be affected by social stimuli. Ferster (1961), who presents the argument within reinforcement theory, hypothesized that the social environment has no secondary reinforcing function for the autistic child, hence the child fails to develop the appropriate behaviors. Like Ferster, Rimland (1964) hypothesized that the failure of autistic children to develop normally is based on failure in the acquisition of meaning in social stimuli. Rimland attributes such failure to central nervous system pathology, while Ferster relates it to inadequate parent-child relationships. Similarly, psychodynamically oriented writers point out that social stimuli fail to operate normally for autistic children. For example, Betz (1947) regards autism as the establishment of a rather impermeable interpersonal barrier, which shuts off social stimuli. Psychodynamic orientations conceptualize such barriers as defense mechanisms against prior interpersonal trauma.

If one worked within a reinforcement theory paradigm, one could facilitate the behavioral development of autistic children in two ways. One could circumvent the use of social stimuli altogether, and build behaviors by relying on primary ("biological") rewards, such as food. At present, there is ample evidence to demonstrate that autistic children will acquire new behaviors when primary reinforcement is used. The use of primary reinforcement has an obvious disadvantage, in that special environments need to be established to develop and maintain the new behaviors. Since we have inadequate information about how to construct such environments, the results of therapeutic efforts would probably fall short of the ideal.

A second alternative would be to concentrate treatment efforts on facilitating the autistic child's acquisition of social reinforcers, rather than on building behaviors. A treatment program centered on the establishment of a normal hierarchy of social reinforcers would give the child's every-day social environment (his parents, teachers, peers, etc.) the tools with which to build and modify the myriad behaviors necessary for the child to function effectively within that environment. In a sense, the person's behavioral changes would "take care of themselves," provided he returned from treatment to a normal environment, with a normal reinforcement hierarchy. This same point has been made by others, in somewhat different terms. For example, it seems implied when psychotherapy is described as a situation where changes in "meanings" or "values" (conceivably, reinforcing properties, in part) of certain interpersonal events are effected, rather than one in which behavior is directly manipulated. The advantage of conceptualizing these changes within behavior theory might lie within the more explicitly stated operations for bringing such changes about. The present study took its direction from behavior theory conceptualizations.

In view of these considerations, it seems of major importance to establish whether autistic children can, in fact, acquire social reinforcers. One can

conceive of social stimuli acquiring power in two ways: by association with the presentation of a primary positive reinforcer, or by the removal of a primary negative reinforcer. Data (Lovaas, Schaeffer, and Simmons, 1965b) already demonstrate that social stimuli can acquire positive reinforcing power for the autistic child by being associated with pain reduction. Because of the moral and ethical problems associated with the therapeutic use of pain, it is important to determine whether social stimuli can acquire reinforcing properties for autistic children by being associated with the presentation of already powerful reinforcers. In other words, will an autistic child seek the presence of someone associated with his attainment of basic gratifications, who has given him pleasure, so to speak?

Although empirical evidence shows (Kelleher and Gollub, 1962) that one can sometimes establish a previously neutral stimulus as an acquired reinforcer, via the classical conditioning paradigm (consistently associating a neutral stimulus with one which already has reinforcing properties), we failed to observe such effects in the two children with whom we worked. We did pair, in several hundreds of trials, the word "good" with food delivery. (Essentially, *E* would say the word "good," and at that time give the child a bite of food.) Subsequent tests of "good" for secondary reinforcing properties were negative; there were no modifications in the child's behavior when that behavior was accompanied by "good." In fact, despite all these pairings, he behaved as if he had never heard the word; he did not attend to, or otherwise respond to our behavior.

We had anticipated this failure, for two reasons. First, the experimental manipulations merely replicated to a lesser degree what the children had experienced in the 2 years of in-patient treatment, prior to the experiment. During those 2 years, people had lavished affection on them (fed, rocked, and played with them, etc.). Despite those 2 years of intensive work, the children still behaved as if they had never seen, or heard the staff personnel—they were completely unresponsive to any social stimuli. They behaved "as if" they were blind and deaf, which is diagnostic of autism. The second reason for anticipating failure was based on the literature on classical conditioning (Maltzman, 1965) which points out that, unless the organism attends to, or orients toward the conditioned stimulus, learning will fail to occur. Casual observation suggests that children such as these fail to attend to social (or almost any external) stimuli to a profound degree. This failure in attention is exactly what Bernal's (1965) data support. Using the galvanic skin response (GSR) to novel stimuli as indicative of attention (orienting behavior), Bernal's *S*s either failed to give attending behavior, or gave such behavior only sporadically. Bernal states the implications of such failure "... if a child cannot selectively attend to, or orient toward, a stimulus, the pairing of a biologically important event with that stimulus will not result in its taking on reinforcing properties" (p. 1).

The procedure which we developed, whereby the social stimulus eventu-

ally acquired reinforcing properties, involved an initial training in which the child was "forced" (or enabled) to respond to (hence, attend to) the social stimulus. To establish a social stimulus as a *discriminative stimulus* for the primary reinforcer (food), before making use of its acquired reinforcing properties, is consistent with Dinsmoor's hypothesis (1950). This hypothesis states that a stimulus will take on reinforcing properties, insofar as *S* can discriminate that stimulus, as a necessary concommitant of reinforcement, or nonreinforcement. In our efforts, we relied heavily on Zimmerman's (1959) work, which demonstrates how a secondary reinforcer may be made durable and stable, in rats. This method depends upon intermittent reinforcement, both in establishing the previously neutral stimulus as discriminative for food, and in the delivery of that stimulus as a secondary reinforcement, contingent upon new behavior.[1]

METHOD

Subjects. Four-year-old identical twins, schizophrenics, with marked autistic features, served as *S*s (labeled *S*1 and *S*2). They had been hospitalized for 2 years prior to this study, and had shown no noticeable modification of their behaviors. Pre-experimental tests were consistent with clinical impressions that social stimuli were ineffective; they were completely unresponsive to people, and evidenced no social behavior. They did evidence a great deal of self-stimulatory behavior (e.g., rocking, excessive fondling of parts of their bodies, arm-flapping, spinning objects), as well as tantrum behavior (screaming, throwing objects, etc.).

The *S*s were seen for two experimental sessions per day (at about 9 AM and 4 PM), 7 days per week, for the duration of the study. Their food intake was restricted to the experimental sessions, although they received water ad libitum after 6 PM, to avoid dehydration. They were restricted from any social interactions outside the experimental sessions, except those involving routine hospital checks.

During the week preceding this study, both *S*s had been successfully trained to follow the commands, "come here" and "sit down," in an escape-avoidance paradigm based on electric shock. Furthermore, their self-stimulatory and tantrum behaviors had been extinguished by shock.

Setting. The experiment was conducted in an experimental room which was connected to an adjoining observation room by a one-way screen. An observer recorded *S*'s behavior and the experimentally controlled variables, on

[1] The reader may also want to consult Zimmerman, Joseph. Technique for sustaining behavior with conditioned reinforcement. *Science*, 1963, **142**.

an Esterline Angus pen recorder. The recording method was described more completely in another paper (Lovaas, Freitag, Gold, and Kassorla, 1965a).

Two *E*s (experimenters *E*1 and *E*2) were present in the experimental room with *S*. The *S* sat beside *E*2; *E*1 sat apart from *S* and *E*2.

The experimental procedure consisted of two phases. The first phase consisted of establishing a social stimulus as discriminative for food; the second phase involved a test of the social stimulus for any reinforcing power it might have acquired in the first phase.

Training to establish the social stimulus as discriminative for food. The purpose of this training was to establish a previously neutral social event as a sign that food might be available. For *S*1, the social event consisted of *E*2 patting him on the back, and *E*1 saying the word "good"; for *S*2, the social event consisted only of *E*1 saying "good." Briefly, *S* would be fed only if he approached *E*1 when these social events were presented. Since he was fed only when *E* presented the social events, the child had to "pay attention" to the social event presented in order to receive food. The social event was the only sign that food was available; however, it did not become a certain sign, since *S* was not always fed when he approached *E*.

The training to establish the social stimulus as discriminative for food was accomplished in three steps. First, *S* was trained to approach *E*1, then he was trained to approach *E*1 only when the social stimulus was presented. Finally, he was trained to approach *E*1 when the social stimulus was presented, even though he was only intermittently reinforced for the approach behavior. The steps were achieved in the following manner:

Step 1. The *S*1 was seated beside *E*2, directly in front of *E*1. At intervals, varying from 5 to 20 seconds, *E*1 said the word "good," raised his hand to show *S*1 a small bite of food (about the size of a sugar cube), while at the same time *E*2 patted *S*1 on the back. The *S*1 invariably would approach the food and consume it. As soon as *S*1 had consumed the food, *E*2 would say "come here" and "sit down." (Responses, i.e., *S*1 approaching *E*1 independently of *E*1's signals, were immediately followed by *E*2's command to "sit down." The two behaviors—to approach *E*1 at *E*s' signals, and to sit and wait—were established within the first 90 trials of the first session.

Step 2. In Step 1, *S* might not have been responding to the social stimulus ("good" and pat). He might have been making the appropriate discriminations only by attending to the sight of food. In order to force *S* to respond to the social stimulus, in the second session he was gradually moved behind a partition about 6 feet away from *E*1. He continued to sit beside *E*2, but out of view of *E*1 and the food. This step forced *S* to respond to the social stimulus, rather than the sight of food—if *S* was to receive any food at all, he had to discriminate ("attend" to) the social stimulus. Not only was the sight of food removed, but other stimuli on which *S* could base his discrimination were also removed. For example, *E*1 made certain that sounds of his retrieving food were

masked, and the intervals between the social stimulus presentations were varied so as to rule out temporal cues, and so on. Training in Step 2 was accomplished within the first 90 trials of the second session.

Step 3. This step was initiated in the third session, and consisted of the introduction of unreinforced trials. In a very gradual manner, over the next sessions, the schedule of reinforcement for *S*1's approach behavior was shifted from 100% reinforcement (food every time he approached) to a VR20 (*S* received food on an average of once out of every 20 approaches). Figure 3-8 shows more exactly the number of reinforcements given per trials. Step 3 lasted for 13 sessions, totaling 1530 trials.

Test of the social discriminative stimulus as an acquired reinforcer. This phase of the study consisted of determining whether the social stimulus ("good" and

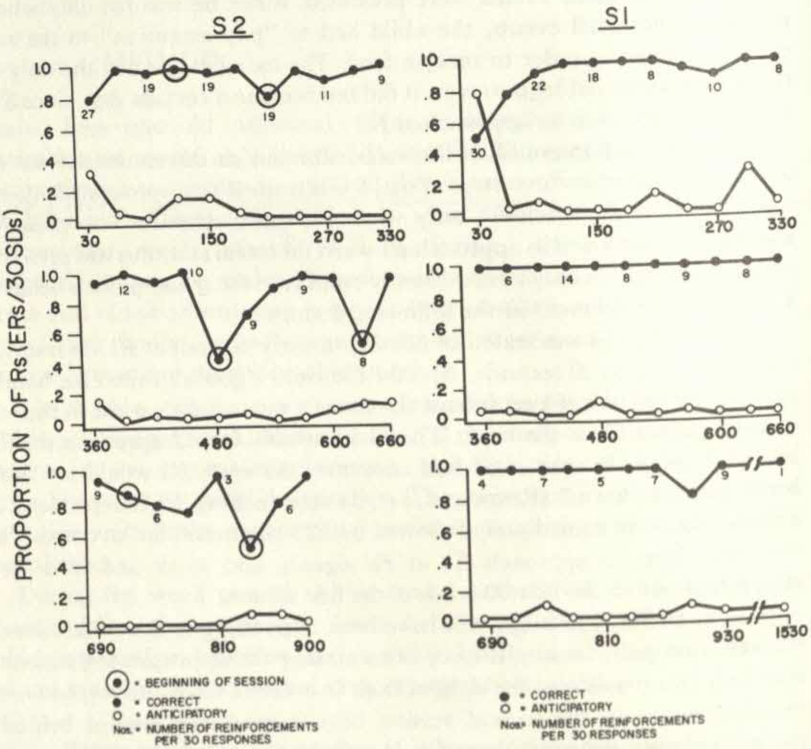


Figure 3-8. The performance of *S*1 and *S*2 from the discriminative stimulus training. The abscissa is in units of 30 trials. The ordinate gives the proportion of correct and anticipatory (incorrect) responses. The numerical values immediately below the line for correct responses gives the number of reinforcements per 30 trials. Encircled points (for *S*2) give beginnings of sessions.

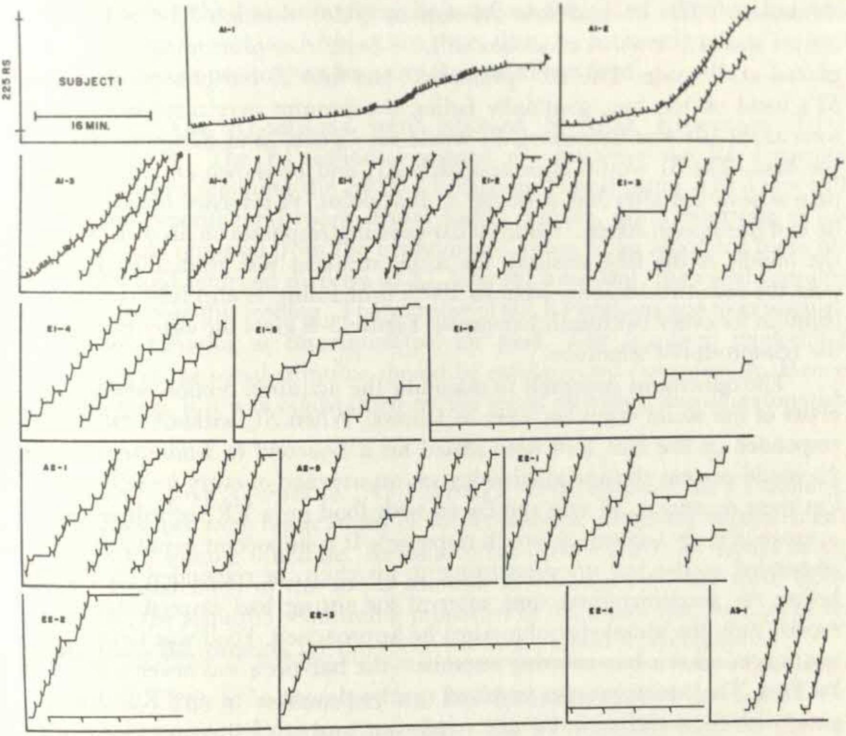


Figure 3–9. The *S*1's performance on the bar as cumulative curves. The upward pointing hatchmarks on the curves indicate delivery of the social stimulus contingent upon bar-pressing. The downward pointing hatchmarks indicate the presentation of the social stimulus as discriminative for food during the A-sessions, and mark time out for feeding during the E-sessions.

pat), which had been trained as a discriminative stimulus for food in the earlier phase, could serve to establish and maintain a new response when it was delivered contingent upon that response. The test was made by delivering the social stimulus contingent upon a bar-pressing response.

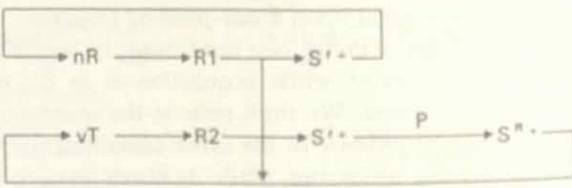
The test was made under two conditions. In one of the conditions, the social stimulus was tested while acquisition of its discriminative stimulus properties was continued. We shall refer to the sessions in this condition as *A-sessions* (A for acquisition). In the other condition, the social stimulus was tested for reinforcing properties, while its discriminative stimulus properties were being extinguished. These sessions are labeled *E-sessions* (E for extinction). The *S*1 had three sets of A-sessions (A1, A2, and A3), interspersed with two sets of E-sessions (E1 and E2). The nature of these sessions will be described in more detail.

A1-sessions. The $S1$ had four A1-sessions (A1-1 through A1-4). The procedure was as follows. A small box with a 6-inch lever protruding in front was placed at $S1$'s side. The $E2$ "prompted" the first 20 bar-presses by placing $S1$'s hand on the bar, gradually fading the prompt over these sessions. As soon as the bar was depressed, $E1$ would say "good" and $E2$ would pat S on the back. The $S1$ would then approach $E1$, and be shown an empty hand; he was never fed after bar-pressing. At that point, $S1$ returned to his chair, as he had previously. After S made 20 bar-pressing responses on his own (toward the middle of the first session), the social stimulus was gradually changed, over the next two sessions, from its 100% scheduling to an FR20 (one social stimulus for every twentieth bar-press). Figure 3-9 gives the exact changes in the reinforcement schedule.

The operations designed to maintain the acquired reinforcement properties of the social stimulus were as follows. When $S1$, without first having responded on the bar, had been seated for a 3-second to 3-minute interval, Es would present the social stimulus, on an average of every fourth minute. On these occasions, $S1$ was reinforced with food on a VR2 schedule (on an average of every second approach response). It is important to note that if $S1$ responded on the bar upon returning to his chair, or responded on the bar before the predetermined time interval for sitting had elapsed, he would receive only the social stimulus when he approached. Food was never given contingent upon a bar-pressing response—the bar-press was never reinforced by food. The two schedules involved can be described as an FR20 for bar-press with the social stimulus as a reinforcer, and a VI 4 minutes for sitting, with food as a reward. The bar-pressing response canceled out the sitting contingency. Montrose Wolf,[2] using Mechner's notations (1959), has diagrammed the procedure in Table 3-1.

In a sense, S was caught in a dilemma, in the A-sessions. When he returned to his chair and pressed the bar, he always received the social stimulus, but was never fed. If he returned to his chair and just sat, without

Table 3-1. Diagram of the schedule combinations*



*Where nR=20; R1=bar press; S^{r+}="good"; vT=4 minutes; R2=sitting in chair; S^{R+}=food; p=.5.

[2] Of the University of Kansas; personal communication.

responding on the bar, sometimes he received the social stimulus, but was only fed once in a while. Most of the time, then, he received nothing for just sitting, unless he pressed the bar, and that ruled out food.

E1-sessions. The A1-sessions were followed by nine E1-sessions (E1-1 through E1-9). The E1-sessions consisted of removing the VI 4-minute schedule, while retaining the FR20 schedule for bar-pressing. The *S* was still fed in the experimental room. Every fourth minute, upon returning to his chair, he was removed from the experimental room to an adjoining room for 1 minute, and returned directly to *E*1, who fed him. But, the social stimulus did not precede this feeding. The purpose of the E1-sessions was to extinguish the social stimulus as discriminative for food. The acquired reinforcing properties of the social stimulus should be extinguished concurrently. Hence the bar-press, if it was maintained by the social stimulus, should extinguish as well.

A2-sessions. Five A2-sessions (A2-1 through A2-5) followed the E1-sessions. The A2 sessions were replications of the A1-sessions, involving reinstatement of the VI 4-minute schedule. Reinstatement of this schedule should bring about reinstatement of the social stimulus as discriminative for food. Concurrently, the acquired reinforcing properties of the social stimulus should be established. Bar-pressing for the social stimulus should be recaptured.

E2-sessions. The A2-sessions led into four E2-sessions (E2-1 through E2-4). These sessions replicated the E1-sessions—the VI 4-minute schedule (hence the food) was removed. These sessions were followed by the third and last presentation of the A-sessions.

A3-session. This session was a replication of the other A-sessions, i.e., the VI 4-minute schedule was introduced once more. This step lasted for only one session (A3-1), and terminated the study.

In summary, sessions A1, A2, and A3 were replications of each other. These steps involved two schedules. One was designed to test the reinforcing properties of the social stimulus (FR20), and the other was designed to maintain the social stimulus as discriminative for food (VI 4 minutes). Sessions E1 and E2 were replications of each other; they maintained only the schedule designed to test the reinforcing properties of the social stimulus. The other schedule (VI 4 minutes) was not in effect, thus producing extinction of the social stimulus as discriminatory for food, and concurrent extinction of the social stimulus as an acquired reinforcer.

The *S*2 went through the same training and testing as *S*1, with the following exceptions:

1. The *E*2's pat on the back was eliminated from the onset; *S*2 received only *E*1's "good" as the social stimulus.

2. The $S2$ had eight sessions, with a total of 900 trials, of acquisition of "good" as discriminative for food (as compared with 13 sessions and 1530 trials for $S1$). The $S2$'s food reinforcement during this training reached a VR10 schedule (as compared to a VR20 schedule for $S1$).

3. The $S2$ was on a FR15 schedule for bar-pressing, as compared to $S1$'s schedule of FR20.

4. The $S2$ received six A1-sessions, six E1-sessions, and one A2-session. E2- and A3-sessions were eliminated.

5. When the VI 4-minute schedule was removed in the E-sessions, $E1$ did not feed $S2$, as he had $S1$. Instead, another adult would enter the experimental room every fourth minute, contingent upon S returning to his chair, and preceding bar-pressing. This person would feed $S2$ at a distance of 6 feet from both Es.

Recordings. While the social stimulus was being established as discriminative for food, the observer recorded, on the Esterline Angus pen recorder, the experimentally controlled stimuli, and S's behavior. The stimuli consisted of "good," the pat on the back, delivery of food, "come here," and "sit down." The S's behavior consisted of "correct approach behavior," i.e., approaching $E1$ within 3 seconds of the presentation of the social stimulus, and "anticipatory approach behavior," i.e., approaching $E1$ at intervals other than those specified as correct approach response.

During the test of the social stimulus as an acquired reinforcer, all recordings were made on a Davis Cumulative Recorder. Recordings were made of S's bar-presses (the bar was wired into the cumulative recorder), the delivery of the social stimulus, and the times at which the social stimulus was presented independently of the bar-press, but discriminative for food delivery. Additional recordings were made of the times at which $S1$ was removed from the experimental room, or $S2$ was fed by the "visiting" adult.

RESULTS

The establishment of the social stimulus as a discriminative stimulus. The results of the training to establish the social stimulus as discriminative for food are presented in Figure 3–8. The abscissa is in units of 30 trials. The ordinate gives the proportion of correct and anticipatory (incorrect) responses. The data presentation begins with the third session of the training; this is after S had been moved behind the partition and had begun to respond to the social stimulus, but had not yet been moved on to an intermittent schedule. The numerical values above the abscissa (and immediately below the line for correct responses) give the number of reinforcements per 30 trials. These values show how, in a very gradual manner, S was moved to an increasingly intermittent schedule of reinforcement for responding to the social stimulus.

By examining the data for *S*1, it is easy to see that he performed more than adequately. From the very beginning, his performance was almost without errors (from trials 930 to 1530 it was errorless; hence those trials have been excluded from the figure).

The *S*2's performance is almost as perfect as that of *S*1. The *S*2 has the same low proportion of anticipatory responses as *S*1, but his correct response rate is more variable. In particular, he shows a between-session extinction; his performance at the beginning of each session falls below the level of performance he had reached at the end of each preceding session.

In summary, it is apparent that both *S*1 and *S*2 were successfully trained to respond to the social stimulus in order to be fed, and to continue to respond to that stimulus even when food was rarely delivered.

Test of the social stimulus as an acquired reinforcer. As has been stated in the Method section, the social stimulus was tested for acquired reinforcing properties in two situations. In one, the social stimulus was maintained as discriminative for food (via the VI 4-minute schedule). These sessions are referred to as A-sessions. In the other situation, the social stimulus was tested for reinforcing properties, while its discriminative stimulus properties were being extinguished (the VI 4-minute schedule was removed). These sessions are referred to as E-sessions. The A- and E-sessions were alternated.

The data from *S*1 during these tests are given in Figure 3-9. The Figure gives *S*'s rate of response on the bar in the form of cumulative curves. The upward pointing hatchmarks on these curves indicate delivery of the social stimulus as reinforcement for bar-pressing. The downward pointing hatchmarks indicate the presentation of the social stimulus as discriminative for food during the A-sessions, and times out for feeding during the E-sessions.

As can be observed, during the first run-through of the A-sessions (A1-1 through A1-4), *S*1 moved gradually from the low response rate of session A1-1, up to the high rate of 785 responses in the 36-minute long session of A1-4. One can also observe the gradual shift in the scheduling of the social reinforcement, from its continuous delivery in session A1-1, to FR20 by the fourth session (A1-4). It is also apparent that *S*'s response came under the control of the schedule; he gives bursts of 20 responses by the fourth session.

The A1-sessions were followed by E1-sessions (E1-1 through E1-9). In these sessions, the schedule which maintained the discriminative properties of the social stimulus was removed. If the reinforcing properties of the social stimulus were dependent upon its discriminative properties, these sessions should extinguish the reinforcing properties. The social stimulus should cease to maintain the bar-pressing behavior. The *S*1's rate of response during the E1-sessions shows an initial increase (1100 responses in the 48-minute E1-1 session), followed by a gradual decrease over the subsequent sessions (to a low of 100 responses in E1-9). Sessions E1-6, 7, and 8 are not presented in Figure 3-9, since they add little to the data—the rate shows a gradual dropping off.

The *S*1 gave the very substantial total of 6000 responses to the social stimulus during the E1-sessions; that is, even as the social stimulus was losing its discriminative properties, it maintained considerable behavior.

The remaining A- and E-sessions were replications of the first two. In the second presentation of the A-sessions (A2-1 through A2-5), when the VI 4-minute schedule was reintroduced, and the discriminative properties of the social stimulus were re-acquired, *S*'s previous rate of response for the social stimulus was immediately recaptured. His rate stayed stable and high throughout the five sessions (A2-1 through A2-5). Sessions A2-2, 3, and 4 are not presented in the Figure, because the rate and response characteristics of A2-1 and A2-5 are maintained.

The second presentation of the E-sessions (E2-1 through E2-4) shows *S*'s rate falling off more quickly than it did the first time the E-sessions were presented. By the last of these sessions (E2-4), the secondary reinforcing properties of the social stimulus appear fully extinguished—they maintain no behavior.

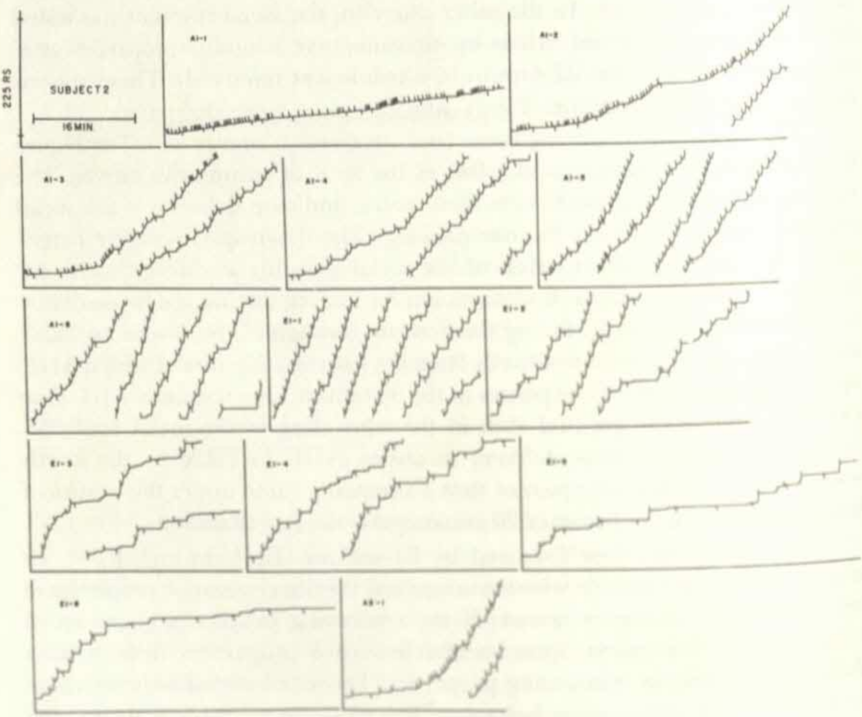


Figure 3–10. The *S*2's performance on the bar as cumulative curves. The upward pointing hatchmarks on the curves indicate delivery of the social stimulus contingent upon bar-pressing. The downward pointing hatchmarks indicate the presentation of the social stimulus as discriminative for food during the A-sessions, and mark time out for feeding during the E-sessions.

In the third and last presentation of the A-sessions (A3-1), it is apparent that *S*'s rate of responding for the social reinforcer has been fully recaptured—the reintroduction of the social stimulus as discriminative for food immediately reinstates its power as a reinforcing stimulus for the bar-pressing behavior.

The *S*2's performance during the test of the social stimulus as an acquired reinforcer is presented in Figure 3–10. The notations in this figure are identical to those given for *S*1 in Figure 3–9. A comparison of Figure 3–10 with Figure 3–9 shows the behaviors of the two *S*s to be so similar as to make a separate description of *S*2's behavior redundant. It is probably sufficient to state that, in the A1-sessions, *S*2 acquired and maintained bar-pressing behavior on the basis of the delivery of the social stimulus for that behavior. When the schedule maintaining the discriminative stimulus properties of the social stimulus was removed (sessions E1-1 through E1-6), *S*2's rate of response on the bar for the social stimulus shows an initial increase (E1-1), followed by a gradual decline. Reinstatement of the discriminative stimulus properties of the social stimulus increased his rate of response on the bar (A2-1). The *S*2's acquisition of the bar-pressing response was somewhat slower than *S*1's (in both A1- and A2-sessions), and the control exercised by the schedule over *S*2's rate was less marked than in the case of *S*1. We did not attempt to assess the antecedents of these differences, and judged them to be unessential to the understanding of the main variables involved in this study. In view of the similarity of *S*2's performance to that of *S*1, the E- and A-sessions were not replicated further.

DISCUSSION

The results can be summarized as follows: (a) Two schizophrenic children, characterized as autistic (i.e., socially unresponsive), acquired social reinforcers which were used as rewards in training new behaviors, and (b) conditions were arranged under which these acquired reinforcers showed no signs of losing their reinforcing properties over extended sessions. These findings will be discussed separately.

Acquisition of the social reinforcer. Three operations were considered important in these children's acquisition of the social reinforcer. These operations included: (a) discriminative stimulus training, (b) intermittent scheduling of reinforcement during that training, and (c) suppression of self-stimulatory behaviors.

The most important operation was the establishment of the social stimulus as a discriminative stimulus. Zimmerman (1959), from whose findings the present study took direction, provides a comprehensive discussion of it. Briefly, the discriminative stimulus training forced (or enabled) the child to discriminate (hence attend to) the social stimulus. The child's behavior to the social stimulus confirmed that he was attending to it. Without this dis-

crimination training, the social stimulus did not acquire reinforcing properties. We failed to establish the social stimulus as a reinforcer via the classical conditioning paradigm, i.e., by merely associating the social stimulus with food delivery without prior discrimination training. Similarly, Bernal (1965) was unable to classically condition a 10-year-old autistic child. Furthermore, she failed to observe orienting behavior in the six autistic children she studied. A failure to orient (attend) to neutral stimuli would yield failure in classical conditioning.

Perhaps the failure of autistic children to acquire new behaviors and stimulus functions through classical conditioning is part of the explanation for their failure to benefit from traditional psychotherapy. This assumes that aspects of psychotherapy with autistic children conform to classical conditioning paradigm. Such an assumption seems very plausible on the basis of written accounts of psychotherapy with autistic children. In these accounts, the therapist is described as associating himself with gratifications which he offers the child with the intent of establishing himself as meaningful to the child, e.g., as a symbol of gratifications. For example, Rank (1950) writes, ". . . in order to make contact with the child the therapist offered her person as a token of the outside world. Bodily closeness is combined with rhythmic movement and musical sound, the therapist sitting in a rocking chair with the child in her lap, singing nursery rhymes at first and later singing to her in a conversational way instead of speaking" (p. 58). Bernal's and our data suggest that such interventions would be unsuccessful.

The considerations presented here support clinical observations that a basic problem of autistic children centers on inadequate attending behavior (they behave as if they were blind and deaf). A treatment technique which did not remedy this would not enable the child to discriminate the social stimuli involved and, hence, would not allow the child to acquire social reinforcers. Such a treatment technique would be inadequate, according to reinforcement theory.

This conclusion does not necessarily pertain to normal children who, by definition, do discriminate (selectively respond to) social stimuli—probably on the basis of their histories of discrimination training with respect to these stimuli. Such children should acquire reinforcing stimuli merely by pairings of the stimuli to be acquired with already powerful reinforcers. Furthermore, we have some evidence which indicates that prior discriminative stimulus training is not necessary when one employs aversive stimuli, such as electric shock, in association with social stimuli. In one study (Lovaas *et al.*, 1965b), a social stimulus (the word "no") was paired with delivery of electric shock and acquired negative reinforcing properties. There are several possible explanations for this finding. Perhaps the electric shock increased *S*'s attention to external stimuli. Increases in alerting and attending behavior have been observed in animals after delivery of shock (Muenzinger, 1934).

Once a social stimulus was established as discriminative for the primary reinforcer, reinforcement for approaching *E* was intermittent, rather than continuous. This condition was employed to increase the resistance to extinction of the discriminative stimulus and, hence, to produce a more durable secondary reinforcer.

The third operation, employed in establishing the social stimulus as discriminative for food, consisted of the suppression of the large amount of self-stimulatory and tantrum behavior which is characteristic of autistic children. The suppression of these behaviors hastened the children's learning to attend to the discriminative stimulus. The *S*1 had been punished by electric shock for these behaviors prior to the discriminative stimulus training. It was decided to attempt training *S*2 without such prior suppression of self-stimulatory and tantrum behaviors. The *S*2's progress was extremely slow, when compared to *S*1's. His difficulty appeared to be a function of his excessive self-stimulatory behavior, which was incompatible with response to the social stimulus. This inference was based on the observation that *S*2 would approach *E*1 at the sound of "good" only when he was not engaged in self-stimulatory behaviors. Therefore, shock was delivered contingent upon self-stimulatory behavior, bringing it to a near-zero level. Subsequent to this procedure, *S*2 proceeded satisfactorily through training.

The maintenance of the social reinforcer. Despite the intermittent reinforcement employed in the establishment of the social stimulus as discriminative for food, it is apparent, both by definition and fact, that this acquired reinforcer will eventually extinguish its reinforcing properties. This consideration introduces the last observation of this study, namely that conditions can be arranged under which the acquired reinforcer will show no signs of losing its reinforcing properties. That is, in introducing the schedule (VI 4 minutes) which maintained the social stimulus as discriminative for food, it was possible to maintain the social stimulus as an acquired reinforcer for the duration of the study. In the case of *S*1, for example, even after approximately 15,000 responses were emitted for the social stimulus, the stimulus gave no signs of losing its effectiveness as a reinforcer. The particular combination of schedules is probably representative of the way a parent might establish and maintain a behavior solely on the basis of the delivery of a social reinforcer without ever accompanying that behavior by a primary reinforcer. This state of affairs could exist, provided that in another situation the social stimulus was discriminative for a primary or otherwise powerful reinforcer. Parents have to come through, occasionally, by signaling delivery of basic gratifications or removal of actual dangers. We have no basis for stating that the arrangement of schedules employed here acts to permanently prevent extinction of a stimulus' acquired reinforcing properties. It is likely that a discrimination between the two schedules (or behaviors) would eventually develop; i.e., the child would eventually discriminate that bar-pressing never led to food, and

would stop responding on the bar. The more difficult it was to make such a discrimination, the longer the effectiveness of the schedule combination should be maintained. In this particular study, efforts were made to make the discrimination difficult.

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4

IMITATION AND OBSERVATIONAL LEARNING

The previous chapter, on social reinforcement, showed that social stimuli can acquire the ability to reinforce behavior; the present chapter examines some aspects of social stimuli when they function as discriminative stimuli. In imitation and observational learning, as in leadership, one organism provides certain cues that make successful responses possible for another organism. Indeed, imitation and observational learning are special cases of leadership.

Imitation is a social response in which one organism matches the topography of the response of another. The term topography refers to the physical configuration of the response. The children's song, "I put my right hand in, I put my right hand out, I put my right hand in, and I shake it all about," is a topographical approach to behavior. Except in special cases, topography is ignored in the experimental analysis of behavior. One of the advantages of working with the standard operant response is the freedom of the response from the vicissitudes of topography. The gross motor responses used as data by early experimental psychologists were too close to topographical problems. What does "entering a goal box" mean exactly? Does a rat enter a goal box when its nose enters or when its tail enters? What if it enters backwards? On the other hand, a rat may press a bar with one forepaw, or with both forepaws, or in a variety of other topographies. All of these responses are regarded as equivalent by the electronic equipment and the cumulative record. The reliability and usefulness of the data which result from this functional approach testify to its validity.

In imitation, however, the response is defined by a feature of its topography: "sameness' to a response made by another organism. To most people imitative responses seem "natural"; children are called "born mimics." Nearly every human individual will, under some circumstances, imitate the behavior of others. People will imitate specific responses for which they seem to have no

past history of reinforcement. Children will attempt to imitate sounds they have never heard before. Or children reinforced for imitating various desirable responses of their parents will also imitate the cigarette smoking of their parents. Imitative responses seem so inevitable that in early attempts to study imitation, an observing organism was simply placed with the modeling organism. Imitation was then expected to occur with no prior shaping or discriminative training (e.g. Crawford and Spence, 1939). These attempts to obtain imitative behavior met with little success.

On the other hand, reinforcement has been used effectively to develop and enhance imitative responses in children (Baer, Peterson, and Sherman, 1967; Ulrich and Hunt, 1968; Brigham and Sherman, 1968). Once imitative responding is established, it is a highly useful tool in correcting behavioral deficits. Baer, Peterson, and Sherman (1967) reinforced various imitative responses in retarded children. The children not only would imitate the responses for which they were reinforced, but they would also imitate other interspersed responses for which they were never reinforced. Risley and Wolf (1964) used imitative responses to build the verbal repertoire of an autistic child. Also, in Skinner's study of cooperation and leadership (1962), the imitation that developed with leadership occurred in behavior other than that which had been reinforced. Such unreinforced imitative responding has been attributed to the phenomenon of generalization. In the classic example of generalization, a pigeon is reinforced for responding in the presence of a stimulus light of a certain color. When stimulus lights of other colors are presented with no reinforcement, the pigeon will respond, and its rate of response will correspond to the degree of similarity in the spectrum of the new light to the reinforced stimulus light (Guttman and Kalish, 1959). A pigeon reinforced for responding in the presence of a red light will emit unreinforced responses at a high rate in the presence of an orange light. The pigeon will also emit unreinforced responses, but at a lower rate, in the presence of a blue light. Eventually a discrimination will be formed, and the pigeon will respond only in the presence of the red light.

In order for generalization to occur, the organism must attend to the aspect of the stimulus which is being varied. As seen in the study of social reinforcement by Lovaas, et al. (1966), appropriate attentive behavior depends on the history of the organism. Making any aspect of the stimulus discriminative for reinforcement will bring the attention of the organism to it. In addition, certain physiological limitations may affect attention. Rats have very poor eyesight. Generalization along a visual variable would be difficult to establish, especially with auditory and olfactory stimuli functioning in the environment. Similarly, human olfactory receptors are relatively insensitive. People usually discriminate the presence of another organism by seeing it, whereas other animals may make this discrimination by olfaction or hearing.

In Baer, Peterson, and Sherman's study, reinforcement for some imitative responses appeared to generalize to nonreinforced imitative responses. These investigators concluded that the salient factor in the generalization was probably "sameness" or the fact that the unreinforced responses were all imitative responses which occur "naturally."

The first study included in this chapter is a follow-up on the study by Baer, Peterson, and Sherman. Just as it is natural to assume that imitative responses will occur, regardless of the history of the organism, it is tempting to assume that imitation is a "natural" response class. Most people's experience with imitation makes them expect that one organism will, when possible, organize topographically different responses around the unifying concept of "sameness" to a model's responses. Baer, Peterson, and Sherman reflected this tendency when they ascribed the generalization in their study to imitation. The subsequent study, by Peterson, entitled "Some experiments in the organization of a class of imitative behaviors," investigates this assumption.

In the first experiment reported by Peterson, nonreinforced imitative responses were evoked under two procedures: interspersed with reinforced responses, and presented in a group separately from a group of reinforced responses. Although the nonreinforced imitative responses were performed when interspersed with reinforced imitative responses, they were not performed when evoked *en masse*. "Sameness" ceased to appear important, and the stimulus conditions appeared to become the salient discriminative factors. In the second experiment, Peterson required nonimitative responses made in response to another behavior of the experimenter. The results of the second experiment are puzzling, yet again "sameness" did not appear to be important in predicting whether or not the response would occur. Some nonreinforced imitative responses occurred, whereas others did not. In the last two experiments reported by Peterson, the nonimitative responses developed a striking functional resemblance to the imitative responses. Under certain conditions, both imitative and nonimitative responses occurred in spite of the absence of reinforcement for these responses; under other conditions unreinforced responses did not occur.

Peterson's study is complex and deeply involved in the difficult topics of generalization, attention, and discrimination. Although the work does not make clear exactly what controlled the responses, "sameness" appears to be of small import initially, and later appears to be of no import at all. For both the imitative and the nonimitative behaviors the model presented discriminative stimuli that corresponded to a certain response from the subject. Both imitative and nonimitative responses appeared to be under the control of the general experimental conditions. Although human beings do become sensitive to "sameness" as a discriminative stimulus, "sameness" is apparently of little

importance when discrimination of other stimuli results in a higher probability of reinforcement. The discriminative stimuli in combination with reinforcement, rather than any innate tendency to repeat the actions of others, appear responsible for imitation.

In Peterson's study of imitation, the subject was reinforced for imitating or for responding to the behavioral cue of the experimenter. In the topic traditionally known as observational learning, the cue provided by the model includes some consequence of the model's behavior to the model himself. The entire behavior-plus-consequence sequence becomes discriminative to the observer. A person may see another person reinforced for a certain behavior and then imitate the behavior. He may see someone hurt or not reinforced for a certain behavior and avoid that behavior himself. Thus, observational learning may be imitative or nonimitative. The defining factor is that the consequence to the model functions in a discriminative role. Traditional research in operant behavior has dealt mainly with consequences accruing to the experimental organism itself. However, consequences accruing to other organisms can become discriminative; these discriminative stimuli can be of great importance to successful human behavior.

The first study of observational learning presented here is by Darby and Riopelle and is entitled, "Observational learning in the rhesus monkey." The experiment is similar to a shell game with two shells and two players. Food is placed under one of two objects. The first monkey guesses which object conceals the food. Depending on the success of the first, the second monkey must then either imitate or not imitate the response of the first. Although they take turns as observer and demonstrator, the monkeys learn the discrimination quite well. More consistent experimental conditions would have made the learning more efficient. However, the work shows that the complex imitation-plus-discrimination known as observational learning does occur, even in nonhuman animals.

The final paper included in this chapter studies the effect of reinforcement versus the nonreinforcement of the model on imitation and nonimitation. Will an organism which is being reinforced for imitation imitate more readily when the model is also reinforced? The paper is by Rosenbaum and Tucker and entitled, "The competence of the model and the learning of imitation and nonimitation." In the experiments reported, a fictional model made choices of winners in a simulated horse race. Various percentages of these choices were reinforced or punished as the "horse" chosen won or lost. The subjects made the same type of choice. Some subjects were reinforced for imitating the model's particular choice and punished for not imitating it. Other subjects "lost" when they imitated the model and "won" when they did not. The reinforcement of the model had no actual effect on the reinforcement of the subjects. Subjects would win or lose independently of the model's winning or

losing. However, the subjects' past experiences with observational learning could have been expected to give the reinforcement of the model some effect on the subjects' behavior.

In the first experiment reported by Rosenbaum and Tucker, every "correct" response of the subject was reinforced. The effect of the subjects' reinforcement was, in fact, so strong that the effects of the reinforcement of the fictional model were negligible. In the second experiment, the subjects' responses were reinforced on a very high variable-ratio schedule. Eighty percent of the responses were reinforced in a random or unpredictable manner. Reinforcement schedules of this type generally produce a high, steady rate of response. In this case, however, the performances were variable, at least when the results were averaged. The effects on the subjects of different rates of reinforcement of the model were slightly more apparent when the subjects were on a variable ratio than when they were on continuous reinforcement. In summary, reinforcement of the model does seem to have some discriminative function for human beings under certain conditions of reinforcement, but the reinforcement of the responding organism itself is far more powerful.

The fact that the stimuli which control imitation and observational learning are social appears to be of little consequence. If mechanical stimuli could be substituted, the results would probably be equivalent. In extra-experimental nature, the social stimuli involved in imitation and observational learning are so generally discriminative that they have nearly universal effectiveness. Imitation and observational learning allow the necessarily limited chances for learning available to each individual to generalize and to serve in new situations. They are psychological work savers, and in some situations may be life savers. No organism's life is long enough to give experience for each situation to be encountered. Responses to new situations are determined by the similarity of the attendant stimuli to those discriminative in the past. The social stimuli involved in imitation, nonimitation, and observational learning can become important parts of the discriminative repertoires of organisms. The establishment of imitation and observational learning can be useful in treating behavioral deficits and disorders. Imitation and observational learning have been given more experimental attention than have some topics in social behavior. Yet, as Peterson's work indicates, much remains to be learned before a clear understanding can be achieved.

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Some experiments on the organization of a class of imitative behaviors

Robert F. Peterson

Much of human behavior is characterized by a great deal of flexibility. An apparently small or subtle cue may have considerable influence over a wide range of behaviors, causing some to be strengthened and others to be weakened. What is interesting from a behavioral viewpoint are the conditions involved in making these effects so far-reaching. What is indeed curious is the fact that although only a few responses may enter into a contingent relationship with a stimulus, a large number of responses which do not have such a relationship are influenced by the same stimulus. This type of interaction among behaviors is evidence of what has been described as response induction (Millenson, 1967) or as illustrating the operation of a generalized response system or a functional response class (Peterson, 1965, 1967).

The concept of a response class is a descriptive one. The class may be viewed as composed of a number of single responses (Skinner, 1935). The class may be relatively narrow, and therefore include only those responses which resemble one another topographically, such as the behaviors involved in saying "bow-wow," or may be relatively large and include behaviors which

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are topographically different such as crying, hitting, and pulling. Central to the definition of a response class is the observation that a number of topographically different responses have the same relationship to common controlling stimuli. These controlling stimuli may have an eliciting, discriminative, or reinforcing function, and can influence a set of behaviors in such a way that they become interrelated: variables which operate directly on some responses indirectly affect other responses. An example of the operation of a functional response class has been provided in a recent study on the development of imitative behaviors in retarded children by the author and his associates (Baer, Peterson, and Sherman, 1967). In this study the investigators attempted to build a repertoire of generalized imitative behaviors in three severely retarded children. These children were observed at length and judged to possess little, if any imitative behavior. Subsequently, the experimenter began to teach them imitative responses. He looked at a child and said, "Do this" and performed a response such as raising his arm. The child did not imitate his behavior, so he took the child's arm, raised it, said "Good", and gave the child a bit of food. This procedure was repeated a number of times. After a while the experimenter began to reduce his assistance in helping the child perform the response until the only stimulus for the child's response was the initial raising of the experimenter's arm. In this manner the subjects were taught a variety of simple behaviors such as tapping a table, opening a drawer, and putting on a hat.

After the subjects had learned a number of such responses they showed an increasing tendency to imitate new behaviors on which they received no training. By the time two of the subjects had learned some 130 responses, they were able to imitate almost any simple motor behavior the first time it was presented.

In addition, the subjects continued to perform a number of responses which were never reinforced. Although these responses varied in topography, it seemed likely that they were members of the more general class of imitative behaviors and were indirectly under reinforcement control. To test this assumption, a 30-sec delay of reinforcement (DOR 30-sec) was introduced. As a result, both reinforced and non-reinforced imitative responses declined in strength. When reinforcement was again immediately contingent upon an imitative response, both types of responses returned to their former levels. Thus, it appeared that non-reinforced imitative behaviors were under the control of reinforcement and were therefore members of the same response class.

METHOD

Subject and Apparatus. A 12-year-old retarded girl was chosen to participate because she had (before training) evidenced no examples of imitative behavior despite repeated testing. She was without language but would respond to a

few simple commands such as "come here" or "sit down". The child could move about fairly readily and had some simple manipulatory skills. Her most frequent activity was to sit on the floor, kick her legs, and spin a ball.

All experiments were performed in a room near the child's ward. The room contained a desk, two tables, a coat rack, several chairs, and other common office materials. Response times were recorded by a stop watch. Toys and some of the room fixtures were often used as imitative stimulus materials.

General Procedure. The subject was seen at mealtimes, once or twice a day, three to five times a week. Sessions lasted 15 to 40 min. Food was used as a reinforcer and delivered a spoonful at a time by the experimenter, who always said "Good" just before putting the spoon into the subject's mouth. Subject and experimenter faced each other across the corner of a small table on which were placed a food tray and the experimenter's records.

A response was scored as imitative if it either duplicated the topography of the experimenter's response, *e.g.*, putting his hand on his head or if the child used an object in the same way as the experimenter, *e.g.*, rattled the window shade. In addition, the response had to occur within 30 sec of the imitative stimulus. On seven different occasions one of three independent observers also scored the subject's behavior during a session. Since each presentation of an imitative stimulus constituted a separate trial, reliability was computed by dividing the number of trials, where experimenter and observer agreed that imitation had or had not occurred, by the total number of trials (agreements plus disagreements); average agreement exceeded 98%.

The present experiments were concerned with variables influencing the organization of an imitative response class. Assuming that the development and operation of a complex imitative repertoire is important to the acquisition of other behavioral skills (Peterson, 1968), it would appear valuable to know how a response might be added to or removed from such a class. Such knowledge could be useful to the educator, who is interested in building new response systems, and to the clinician, who may want to break up certain kinds of behavioral organization.

Experiment I attempted to demonstrate a technique for removing a response from the class organization. This technique involved successive presentations of an imitative stimulus without reinforcement. Experiments II and III attempted to assess whether the dimension "similarity of behavior between subject and model" was essential for the continued performance of non-reinforced responses. In these experiments the subject was taught a series of non-imitative responses. These behaviors then underwent two different extinction procedures: one involved successive presentations of a stimulus and the other involved an intermittent presentation of the stimulus. The final study, Exp. IV, involved the demonstration of a functional response class which included imitative as well as other behaviors. In this study, reinforce-

ment was withheld from imitative responses to see if other behaviors would also be affected.

EXPERIMENT I

Just before this experiment, the subject had participated in the aforementioned study by Baer *et al.* (1967) and had developed a large repertoire of imitative behaviors. In addition, the subject continued to perform a variety of non-reinforced imitations which were interspersed among reinforced imitations. These behaviors showed no tendency toward extinction and appeared to be members of the general class of imitative behavior.

The goal of Exp. I was to demonstrate a technique for freeing a response from such a class organization. The effects of two types of stimulus presentation were contrasted. The first, termed massed evocation, involved the continuously repeated presentation of an imitative stimulus; the second, labeled interspersed evocation, involved presentation of a single stimulus interposed among other imitative stimuli. In addition, the effect of massed evocation on non-reinforced imitations was determined.

Procedure. Six imitative behaviors, three of which had never been reinforced, were examined. All are listed in the second column of Table 4–1. First, the experimenter took one response from those listed in Table 4–1. He then looked at the subject, said "Do this" and modeled that response. Each demonstration constituted a trial. To be scored, the subject's response had to occur within 30 sec of the demonstration. The subject's behavior was not reinforced. If the subject imitated the response within 30 sec the stimulus was repeated; if the response was not imitated, the experimenter waited a full 30 sec before repeat-

Table 4–1. Responses employed in Exp. 1

Reinforced Responses	Test Responses
1. Sit in chair	1. Put on hat
2. Stand up	2. Tap wall
3. Tap left knee with left hand	3. Tap desk
4. Tap wall	4. Clap sides*
5. Tap head with left hand	5. Clap hands*
6. Say "ee"	6. Remove lid from box*
7. Stand in corner	
8. Say "ah"	
9. Move Kleenex box	
10. Tap right knee with right hand	
11. Tap desk	
12. Put on hat	

*Never reinforced.

ing the demonstration. Extinction was defined as 10 consecutive failures to respond.

Next, using the same verbal command, the experimenter demonstrated two or three of a series of 11 behaviors which, if performed, were reinforced. (The response pool from which these 11 behaviors were selected may also be found in Table 4–1). The order of these 11 behaviors was randomized with each new session. After presenting stimuli for two or three of these (reinforced) responses, the experimenter modeled one of the previously extinguished responses. If this behavior was imitated, it was not reinforced. In all, stimuli for this response were interspersed five times each time the series of 11 behaviors was demonstrated.

In order to minimize possible chaining effects, a 20- to 30-sec pause always followed the subject's imitation or (if no response occurred) the experimenter's demonstration. After one of the six responses had been repeatedly tested, using both massed and interspersed stimulus presentations, other behaviors on the list were similarly examined.

Results

Figure 4–1 shows, for four responses, the percent of S^Ds (trials) imitated under the two stimulus conditions. In each condition the response was not reinforced. The responses "Put on hat" and "Tap wall", however, had histories of reinforcement before this experiment, while the responses "Move lid" and "Clap sides" had never been reinforced. In all cases responses tended to be performed when interspersed among reinforced imitations and were displayed less frequently under massed stimulus presentation.

Similar results may be seen in Figure 4–2, which shows extended tests of two responses under these same conditions. The response "Tap desk" was reinforced during the first two blocks (10 trials) and then mass-evoked. After extinction was achieved, the stimulus for this behavior was interspersed a total of 60 times. Although the response was no longer reinforced, the subject always responded.

The lower part of Figure 4–2 shows a response that had no history of reinforcement ("clap hands") and which underwent periods of both massed and interspersed stimulus presentation. Since the subject's behavior tended to extinguish more quickly in this example, the contrast between the two stimulus operations is even more striking.

Discussion

This experiment demonstrated that under massed stimulus presentation, single responses could be extinguished but were performed when their evoking stimulus was interspersed among other imitative stimuli. One possible explanation for this result may lie in the reinforcement dispensed for other

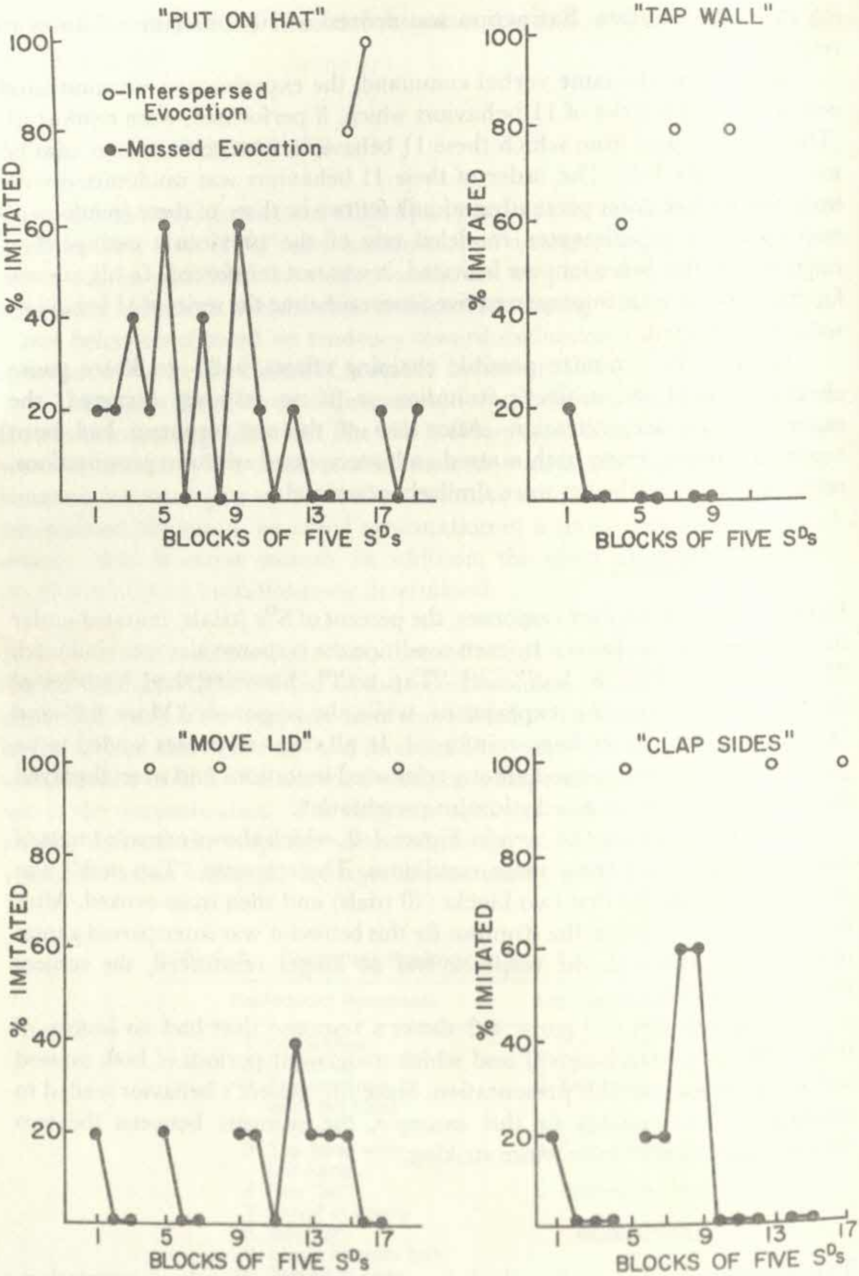

Figure 4–1. The effects of massed *versus* interspersed stimulus presentation on two previously reinforced responses ("Put on hat" and "Tap wall") and two never-reinforced responses ("Move lid" and "Clap sides").

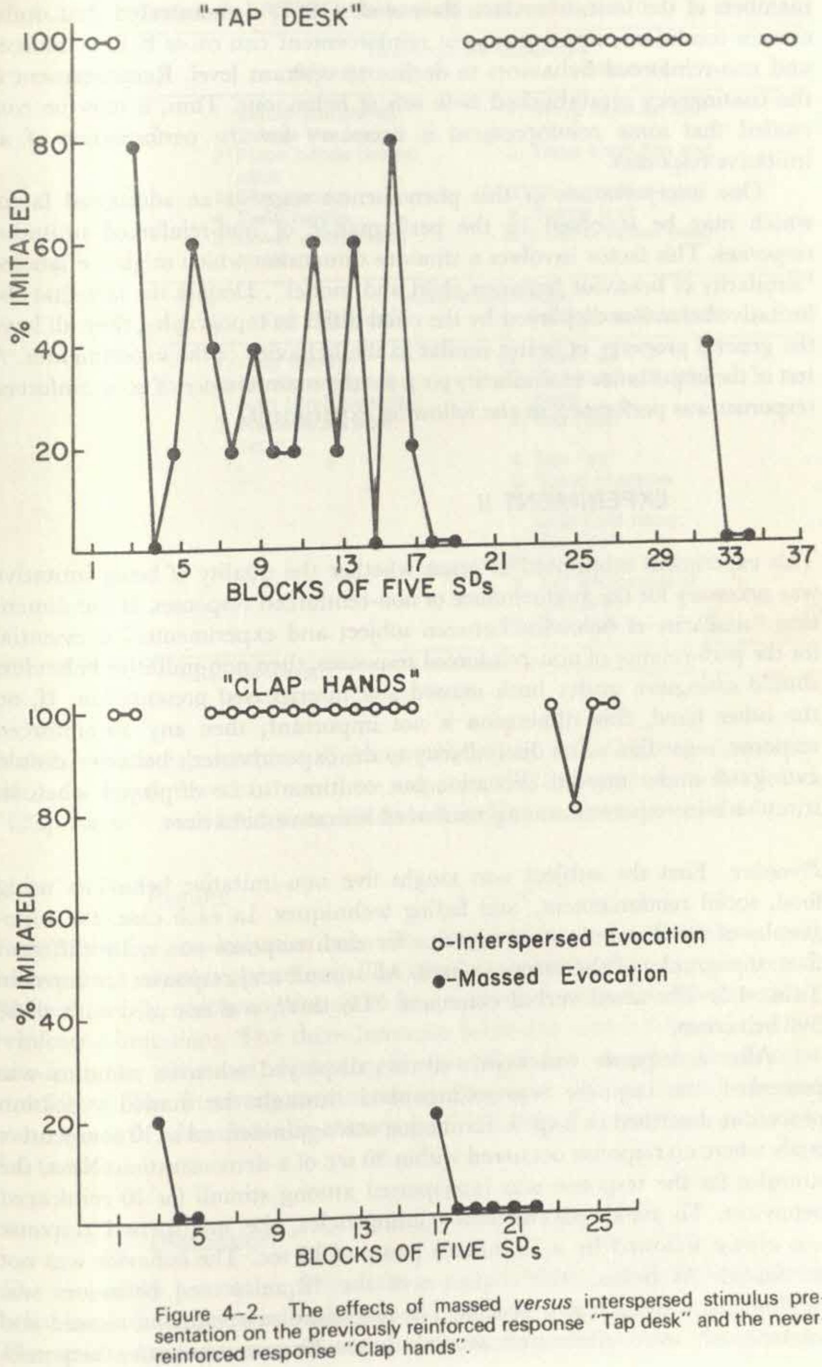

Figure 4-2. The effects of massed *versus* interspersed stimulus presentation on the previously reinforced response "Tap desk" and the never-reinforced response "Clap hands".

members of the imitative class. Baer *et al.* (1967) demonstrated that under certain conditions, non-contingent reinforcement can cause both reinforced and non-reinforced behaviors to decline to operant level. Reinstatement of the contingency reestablished both sets of behaviour. Thus, it may be concluded that some reinforcement is necessary for the performance of all imitative responses.

One interpretation of this phenomenon suggests an additional factor which may be involved in the performance of non-reinforced imitative responses. This factor involves a stimulus dimension which might be labeled "similarity of behavior between child and model". Despite the fact that the imitative behaviors displayed by the child differ in topography, they all have the general property of being similar to the behavior of the experimenter. A test of the importance of similarity *per se* for the maintenance of non-reinforced responses was performed in the following experiment.

EXPERIMENT II

This experiment attempted to assess whether the quality of being imitative was necessary for the performance of non-reinforced responses. If the dimension "similarity of behavior between subject and experimenter" is essential for the performance of non-reinforced responses, then non-imitative behaviors should extinguish under both massed and interspersed presentation. If, on the other hand, this dimension is not important, then any unreinforced response, regardless of its dissimilarity to the experimenter's behavior should extinguish under massed evocation but continue to be displayed when its stimulus is interspersed among reinforced imitative behaviors.

Procedure First the subject was taught five non-imitative behaviors using food, social reinforcement, and fading techniques. In each case, the topography of the discriminative stimulus for each response was quite different from topography of the response itself. All stimuli and responses are listed in Table 4-2. The usual verbal command "Do this", was not used with these five behaviors.

After a response was nearly always displayed when its stimulus was presented, the response was extinguished through the massed evocation procedure described in Exp. I. Extinction was again defined as 10 consecutive trials where no response occurred within 30 sec of a demonstration. Next, the stimulus for the response was interspersed among stimuli for 10 reinforced behaviors. To avoid adventitious contingencies, the interspersed response was always followed by a (minimal) pause of 15 sec. The behavior was not reinforced. As before, the sequence of the 10 reinforced behaviors was randomized with each new session. The two stimulus operations, massed and interspersed, were alternated several times. Five non-imitative responses

Table 4–2. Stimuli and responses employed in Exp. II

Non-imitative Behaviors	
Stimulus	Response
1. Verbal command, "Move the lever."	1. Move lever on toy
2. Place hands behind neck	2. Twist knob (on toy)
3. Clasp knees	3. Shake coffee can
4. Twirl hands	4. Stamp foot
5. Cover mouth with hand	5. Stretch rubber band
Imitative Behaviors	
Test Responses	Reinforced Responses
1. Clap hands*	1. Stand up
2. Move carriage return (on typewriter)	2. Tap head with left hand
3. Remove lid from box*	3. Tap desk
	4. Say "ah"
	5. Stand in corner
	6. Tap right knee with right hand
	7. Say "ee"
	8. Sit in chair
	9. Tap left knee with left hand
	10. Tap wall

*Never reinforced.

underwent these procedures. Subsequently, three imitative behaviors were similarly tested. Two of these three responses, "Remove lid from box" and "Clap hands", were imitations which had no history of reinforcement.

Results

Four of the five non-imitative behaviors extinguished under both massed and interspersed stimulus operations. The exception was the first response tested, "Move lever", which continued to be performed when interposed among reinforced imitations. The three imitative behaviors which followed the five non-imitative responses, however, also extinguished under both stimulus conditions. The first response in this latter group, "Clap hands", showed some strength when initially interspersed, but like the others, its rate soon fell to zero.

Discussion

The aim of the present experiment was to investigate whether the factor of behavioral similarity was necessary to maintain non-reinforced responses. The results, however, are inconclusive because the subject failed to perform

nearly all non-reinforced responses, both imitative and non-imitative alike. It is not clear why these behaviors extinguished. Since, in previous work, it was demonstrated that reinforcement did indirectly control non-reinforced behaviors, one might ask if there was any change in the effectiveness of the reinforcers in the present study. The answer appears to be no, inasmuch as all reinforced responses were performed at their usual high levels.

The subject's failure to respond might have been due to the introduction of non-imitative behaviors. It could be argued that as long as all responses were imitative, it was difficult for her to discriminate those which were reinforced from those which were not. Perhaps the use of non-imitative responses promoted such a discrimination. On the other hand, since the subject had no trouble differentiating one imitative response from another, it is not immediately apparent why she could not also distinguish a reinforced response from one that was consistently unreinforced.

EXPERIMENT III

The purpose of this study, as in the previous one, was to investigate whether the dimension "similarity of behavior between subject and experimenter" was essential to the performance of non-reinforced responses. The plan of the experiment was first to reestablish the performance of unreinforced imitations, and then again test non-imitative behaviors using both massed and interspersed stimulus presentations.

Procedure The experimenter looked at the subject, said, "Do this", and demonstrated two or three of a series of 9 to 10 behaviors, which if imitated, were reinforced. Then the experimenter modeled the stimulus for a non-reinforced imitation. This was followed by other demonstrations of reinforced imitations. Stimuli for a variety of non-reinforced imitations were interspersed three to five times during each series of reinforced demonstrations. If the subject did not readily respond to the stimulus for a non-reinforced response, she was prompted by the experimenter. This prompt consisted of a gentle tug on the child's arm. A minimal pause of 15 sec followed each of the subject's responses. After four sessions of these procedures (271 presentations), stimuli for two non-imitative responses were also interspersed among stimuli for reinforced imitations. No verbal instruction was employed with these behaviors. The non-imitative behaviors received prompts when necessary but were not reinforced. After six sessions (332 demonstrations) using these procedures, three non-imitative behaviors were subjected to successive periods of massed and interspersed stimulus demonstrations. The general procedure was identical to that employed in Exp. I. All stimuli and responses employed in this experiment are listed in Table 4-3.

Table 4–3. Stimuli and responses employed in Exp. III

Non-imitative Responses: Stimuli	Non-imitative Responses: Responses
1. Place hands behind neck	1. Twist knob (on toy)
2. Cover mouth with hand	2. Stretch rubber band
3. Clasp knees	3. Shake coffee can

Imitative Responses: Non-Reinforced	Imitative Responses: Reinforced
1. Sit on floor	1. Stand up
2. Ring bell	2. Tap wall
3. Walk with arms above head	3. Sit in chair
4. Remove lid from box	4. Tap left knee with left hand
5. Clap hands	5. Tap desk
	6. Tap right knee with right hand
	7. Say "ah"
	8. Say "ee"
	9. Hit stapler
	10. Stand in corner

Results

Non-reinforced imitations were frequently displayed by the end of the second training session. The subject was prompted eight times in the first session and once in the second. A final prompt was given when non-imitative behaviors were introduced in session five. Figure 4–3 shows the effects of massed and interspersed stimulus presentations on three non-reinforced, non-imitative, responses. Without exception, these behaviors extinguished under massed evocation but were readily performed when interspersed among reinforced imitations.

Discussion

The results of this study indicate that non-imitative responses are displayed in much the same manner as imitative responses under conditions of massed and interspersed stimulus presentation. Therefore, it would appear that non-reinforced imitative behaviors were not being performed because of their similarity (in terms of being imitative) to reinforced imitations. It is possible, however, that unreinforced responses (imitative and non-imitative) were being maintained because of other similarities to reinforced behaviors. For example, all responses were performed under the same general conditions in the same experimental room. Furthermore, they each have in common the fact that they were cued by the experimenter, *i.e.*, in every case the experimenter "instructed" the subject how to behave. It is possible that these

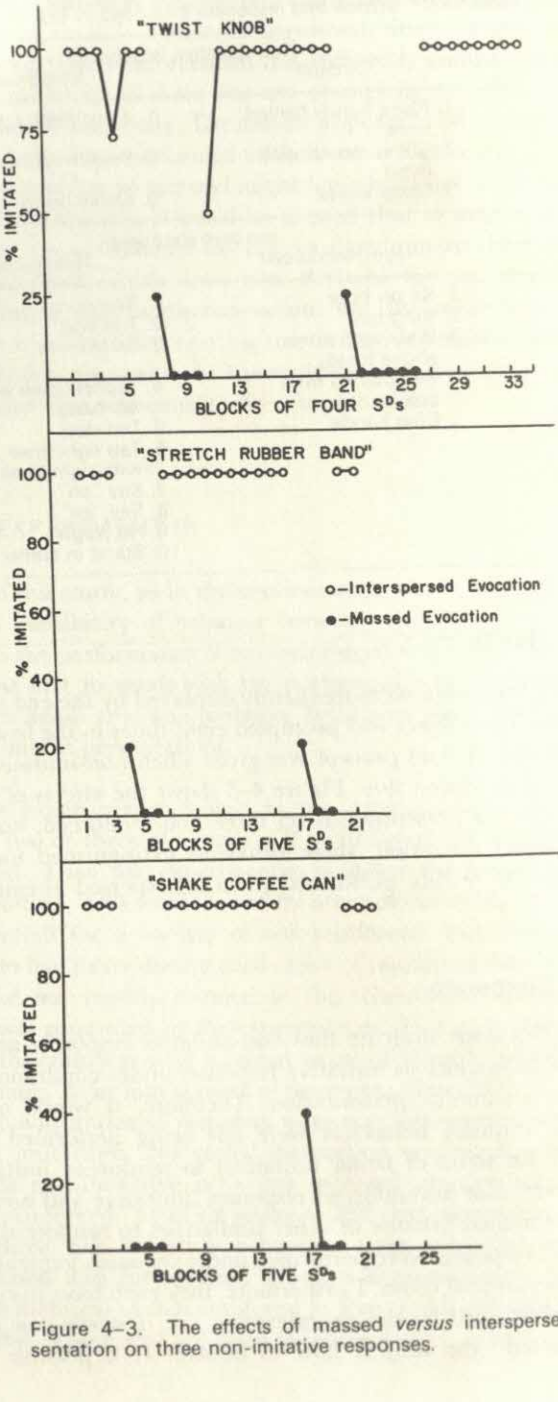

Figure 4–3. The effects of massed *versus* interspersed stimulus presentation on three non-imitative responses.

conditions could create a large response class which includes both imitative and non-imitative behaviors. A demonstration of such a class might elaborate the findings of this experiment.

EXPERIMENT IV

The results of Exp. III suggest that both imitative and non-imitative behaviors may be members of the same response class. This possibility was investigated in the present study by attempting to demonstrate certain functional relationships between the two types of behavior. Thus, this study endeavored to show that variables which operate on one kind of response indirectly affect other types of responses.

Procedure The general procedure differed little from that employed in previous experiments. The subject was instructed to "Do this", and the experimenter then modeled two or three of a series of 10 behaviors which, if imitated, were reinforced. Next, the stimulus for a non-imitative response was presented. Non-imitative responses were not reinforced. Stimuli for four non-imitative responses were interspersed in each series of 10 imitative responses. The sequence of imitative responses was randomized with each new session. A minimal 15-sec pause followed each of the subject's responses. If the subject did not respond within 30 sec of a stimulus, the experimenter modeled the next behavior in the series. After a baseline level of responding had been established, reinforcement for imitative behaviors was discontinued. After a

Table 4–4. Stimuli and responses employed in Exp. IV

Non-imitative Responses	
Stimuli	Responses
1. Place hands behind neck	1. Twist knob (on toy)
2. Cover mouth with hand	2. Stretch rubber band
3. Clasp knees	3. Shake coffee can
4. Twirl hands	4. Stamp foot
Imitative Responses	
1. Put on hat	
2. Tap head with left hand	
3. Stand in corner	
4. Sit in chair	
5. Stand up	
6. Hit stapler	
7. Pull drawer	
8. Pet coat	
9. Tap desk	
10. Tap wall	

short period, reinforcement was again dispensed contingent upon an imitative performance. All stimuli and responses displayed in this experiment are listed in Table 4–4.

Results

The effects of the above procedures are shown in Figure 4–4. Imitations are plotted in blocks of 10 stimulus presentations while non-imitative behaviors are plotted in blocks of four. This graph shows that the subject ceased to perform non-imitative responses as soon as reinforcement for imitative behaviors was discontinued. Forty stimulus presentations later, the rate of imitative responses also declined. When imitative responses were again reinforced, the rates of both types of behavior returned to baseline levels.

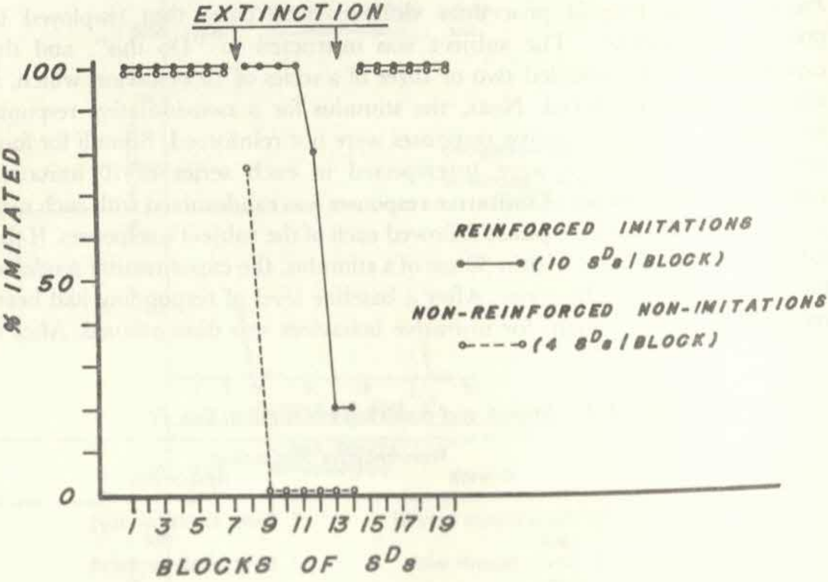

Figure 4–4. The effects of reinforcement withdrawal on imitative and non-imitative behaviors.

GENERAL DISCUSSION

The present experiments suggest that imitative responses appear to satisfy the criteria for a functional response class. These responses, however, should not be conceived of as a rigidly organized behavioral unit in that the results

indicate that imitative behaviors may also be members of an even larger response class which includes non-imitative behaviors as well.

Several arguments have been put forth to explain the performance of non-reinforced imitative responses. In earlier studies, Baer and his associates (1964, 1967) suggested that non-reinforced imitations might be displayed because matching the behavior of the experimenter had been discriminative for reinforcement. Thus, "matching" in and of itself could serve to maintain behavior in the absence of reinforcement.

In contrast, the present results suggest that although the dimension of behavioral similarity may be crucial to the development of a class of imitative behaviors, this dimension probably does not function to maintain non-reinforced imitative behaviors. It is even more unlikely that "similarity" *per se* could be important in the performance of non-reinforced non-imitative behaviors. However, the possibility that other stimulus dimensions may play a role has not been ruled out.

Bandura (1968) has argued that discriminative difficulties may explain the performance of non-reinforced imitative behaviors. He believes that it may be difficult for the subject to discriminate reinforced from non-reinforced behavior since only a small percentage of the behaviors are reinforced. Thus, if a model were to portray a series of reinforced responses followed by a series of non-reinforced responses, the latter would cease to be performed.

Although the ratio of reinforced to non-reinforced responses should undoubtedly be considered in the performance of non-reinforced behaviors, the present results do indicate that under a relatively high ratio of one non-reinforced to two or three reinforced responses, non-reinforced responses were still performed. Since the subject ceased to perform responses which were mass-evoked, but performed those which were interspersed, an explanation in terms of a possible chaining effect might also be examined. In other words, it could be argued that the subject performed the non-reinforced response in order to get to the next reinforced response as quickly as possible. However, the pauses programmed before each demonstration, coupled with the time it took for the subject to imitate the behavior (at least 20 sec, since nearly all of the responses involved going to another part of the room and returning) guaranteed that it would take just as long if not longer to perform the response as it would to wait 30 sec for the next S^D.

In considering any tentative explanation of these results, the reader should keep in mind the possiblity that the behavior of the child studied may be unique; caution should be used in attempting to generalize these findings to other subjects and situations. It is notable, however, that other investigators (Lovaas, 1967; Metz, 1965; Lovaas, Freitas, Nelson, and Wahlen, 1967) have reported a number of similarities between the imitative behavior displayed by their subjects and the present one.

Perhaps the simplest explanation for the performance of non-reinforced behaviors lies with the reinforcement dispensed for other responses. In all of

the experiments, reinforcement contingent on some behavior was necessary for the performance of non-reinforced responses. This was true when the experiment involved both imitative and non-imitative behaviors and massed *versus* interspersed stimulus presentations. The importance of reinforcement in a functional response class and its implications for imitation and identification have been discussed in an interesting article by Gewirtz and Stingle (in press).

The individual responses studied in the present experiments were quite varied topographically. The class they formed could be considered a fairly broad one. When viewed as a unit, the class could also be considered as under the influence of an intermittent schedule of reinforcement. This conceptualization raises questions concerning the boundaries of the class (*i.e.*, its generalization gradient) and those stimulus aspects which in addition to reinforcement may create a functional response class. No doubt the isolation of those dimensions which cause behaviors to interlock and be strengthened or weakened as a unit would prove valuable. Such knowledge would not only further theoretical formulations of multi-operant repertories but would also increase the psychologist's effectiveness in dealing with social, educational, and clinical problems.

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Observational learning in the rhesus monkey

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and
A. J. Riopelle

Numerous attempts have been made to demonstrate that species of animals other than man are capable of learning by observation or imitation. An especially important study for our present purposes is that by Crawford and Spence (1939), who, using two opposing cages with a stimulus tray between them, trained a chimpanzee to observe another depress one of three stimulus objects. After several trials by the demonstrator, the observer was given a test trial to determine if the observer would depress the same object. Both demonstration and test trials continued alternately until the observer either learned the problem or evidenced inability to learn. Results were ambiguous, with only one of eight chimpanzees learning a "pure" imitation problem. The ambiguity of the results suggested that although the general procedure was correct, the stimulus-display conditions were not conducive to rapid discrimination learning.

Data collected since have defined the conditions necessary for rapid discrimination learning by primates (Harlow, 1944; Jarvik, 1953; Jenkins, 1943; McClearn & Harlow, 1954), and it was thought that by utilizing the

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This paper is based in part on a doctoral dissertation submitted to the Graduate School of Emory University (Darby, 1956).

results of these recent researches, unambiguous data might be collected on observational learning. Because of these considerations, we were motivated to try a demonstration of observational learning under more efficient conditions and to learn what we could about factors contributing to successful performance.

Two studies were conducted. In the first, described in detail elsewhere, Darby (1956) placed two monkeys that could solve object-quality discrimination problems in a single trial (i.e., had formed learning sets) side by side in the Emory version (Riopelle, 1954) of the Wisconsin General Test Apparatus (Harlow, 1949). One animal, the demonstrator (*D*), was given 1, 2, or 3 trials on an object-discrimination problem, then another animal, the observer (*O*), was given 3 trials on the same problem. The *O*s made approximately 65% correct responses on their first trials of the 400 problems given. Although intraproblem performance improved rapidly, interproblem performance remained unchanged throughout the series of problems. Also, *O*'s performance was no better after 3 than after 1 or 2 demonstration trials. The results suggested that the display aspects of the stimulus presentation were probably still inefficient. Nevertheless, the results were encouraging, and we undertook the present investigation hoping that, with a few additional alternations in the procedures, the efficiency might be high enough to permit the use of inexperienced monkeys, thereby permitting us to trace the development of proficiency in observational learning.

METHOD

Subjects

Four experimentally naive adolescent and young adult rhesus monkeys (No. 58, 61, 65, 70) were used as *S*s in this experiment. They were subjected to a standardized training and test-adaptation procedure in which they were accustomed to the apparatus, to *E*, and to the displacement of a single object from the test tray in order to obtain a morsel from a foodwell.

The animals were grouped in pairs, each pair constituting an experimental unit. The pairings were maintained throughout the experiment. On a particular problem, one member of the pair served as *D* and the other as *O*.

Apparatus

The device, illustrated schematically in Figure 4-5, consisted of two restraining cages and a sliding test-tray between them. This tray was retracted from the testing location during the baiting and placing of the test objects, and it was returned at the beginning of each trial.

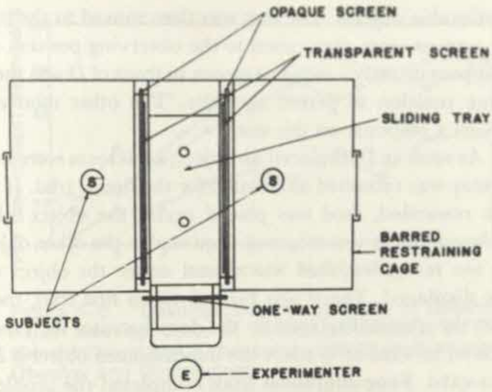

Figure 4-5. Schematic diagram of apparatus.

Two foodwells, 1.5 in. in diameter and 10 in. apart, were drilled in the 12- by 18-in. test board. The distance from the foodwells to the bars of the restraining cages was approximately three-fourths of the maximum reach of the animals.

The cages were completely enclosed with sheet metal with the exception of the side facing the test surface; this was barred. The opaque walls served to restrict observation to the quadrant containing the test tray. Immediately in front of the barred side of the cage was a double screen consisting of an inner, opaque screen, constructed of ¼-in. plywood, and an outer, transparent screen, made of ¼-in. transparent plastic.

The screens were so arranged that the opaque screen could be raised, leaving the transparent screen in place. This arrangement constituted the "observing" position, for the animal could see but not touch the test objects. By raising the opaque screen further, the transparent screen was carried with it, allowing the animal access to the test board. This constituted the "testing" position.

The problems used in testing were drawn at random from the laboratory's random assortment of over 1,000 mutually different stimulus objects.

A one-way screen, fixed at one side of the apparatus, prevented the monkeys from seeing *E*.

Procedure

Testing was initiated after both members of a test pair had entered the restraining cages. All screens were lowered, and the test tray was baited. Depending on whether or not the first, or demonstration, trial (*D* trial) was to be rewarded, food was placed in both or neither (each precisely 50% of the trials) of the foodwells and covered with

the stimulus objects. The tray was then moved to the testing location. The screens were then raised to the observing position and held there for approximately 1 sec. The screen in front of D was then raised to the testing position to permit a choice. The other monkey, O, was not allowed a response on this trial.

As soon as D displaced an object, all screens were lowered and the test tray was retracted and baited for the first O trial. If the D trial had been rewarded, food was placed under the object which had been displaced and it was removed from under the other object. If the trial was not rewarded, food was placed under the object which had not been displaced. The O was then given its first trial, the task being to select the object displayed by the demonstrator on Trial D_1, if D had received reward or to select the nondisplaced object if D had received no reward. Four additional trials completed the problem. The above procedure was repeated in each subsequent problem in the experiment.

Six trials were allowed on each problem, 2 for D and 4 for O. The D was allowed a single trial, and then O was given 1, 2, or 3 trials. Then D was permitted a second opportunity to respond. On each O trial, D was allowed to observe O's response. Following this, O was allowed as many more trials as were necessary to make 4 trials on that particular problem.

The order of presentation, the side on which reward was presented, the sequence in which the observer role was played, and the side on which the animal was placed were all randomly determined.

Between 10 and 15 problems were allowed per day for each pair of animals. Training was continued until each animal had served as O on 500 problems. Necessarily, each animal also served as D on 500 problems. Therefore, every monkey received some training on 1,000 problems.

RESULTS

Figure 4-6 shows the performance of O on its first trial (O_1) and on its second trial (O_2). Also shown is the performance on D's second trial (D_2), that for D_1 having been fixed precisely at 50%. The most important curve is that labeled O_1; it is a measure of how much information O gained by the single demonstration trial. The curve starts at 52% and rises gradually to 75% correct. The linear trend of this curve rose significantly (.01 level), and it shows that as the experiment progressed, the Os learned increasing amounts from the single observation trial on each problem.

Curve O_2 contains the usual learning-set performance; it is superior to O_1 and rises to 90% correct. Curve D_2 shows the same thing for the demonstrator. The slight but consistent superiority of Curve O_2 over D_2 suggests that it is more efficient to have the first observation trial precede a test trial rather than succeed it. Both curves are higher than Curve O_1. This superiority

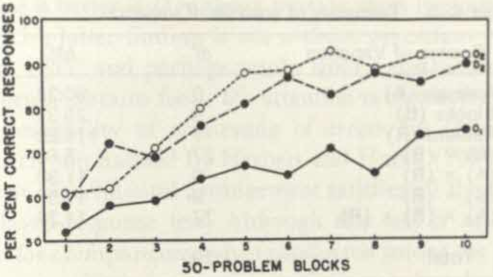

Figure 4-6. Development of proficiency in observational and discrimination learning. Curve O_1 denotes performance by Observer after a single demonstration trial. Other curves denote performance on second trials of Observer and Demonstrator.

of discrimination learning-set performance over observational-learning performance shrinks but does not disappear when the learning-set curves are combined and extended over 1,000 problems rather than over the 500 problems as plotted in Figure 4-6.

What are some of the factors determining observational proficiency? According to Spence (1937), "stimulus enhancement," by which he means that *O* will respond to those aspects of the problem manipulated by *D*, is an important factor, especially in problem boxes. If we apply this argument to the discrimination-learning situation, we would predict that *O* will tend to displace the object displaced by *D*, regardless of whether or not *D* obtained reward. If so, the percentage of correct responses made on Trial O_1 when D_1 was rewarded should be higher than that for responses when D_1 was wrong (unrewarded), for in the former case *O* chooses the same object as was chosen by *D*, and in the latter case it chooses the other object to obtain reward. Figure 4-7 shows these data. In seven out of ten points on the graph, performance on O_1 after a nonrewarded D_1 surpasses that after a rewarded D_1.

The data from which Figure 4-7 was derived contained all the information relevant to the major purpose of the investigation. Those data were

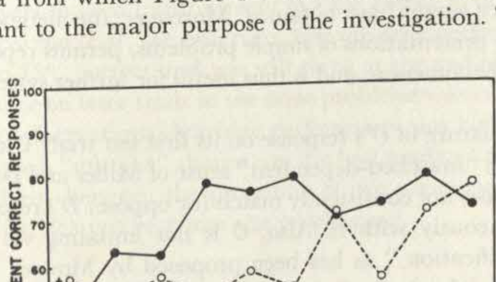

Figure 4-7. Observational-learning performance after a rewarded (+) and after a nonrewarded (−) demonstration trial.

Table 4-5. Summary of analysis of variance

Source of Variation	*df*	*MS*	*F*
Animals (A)	3	50.28	4.45*
Blocks (B)	9	25.37	2.25*
Reward (R)	1	115.20	10.21**
(A) × (B)	27	5.66	
(A) × (R)	3	11.30	
(B) × (R)	9	17.95	1.59
(A) × (B) × (R)	27	11.28	
Total	79		

*$P \lesseqgtr .05$.
**$P \lesseqgtr .01$.

therefore subjected to analysis of variance, a summary of which appears in Table 4-5. In addition to the ever present individual differences, we found a significant difference among blocks of problems, reflecting the overall improvement in performance. Also, whether or not the *D* trial was rewarded was a significant factor in determining *O*'s level of proficiency. The absence of significant interaction effects suggests that the superiority of a non-rewarded *D* trial over a rewarded *D* trial holds for most monkeys and throughout an important portion of the acquisition of proficiency in observational-learning performance.

DISCUSSION

The results of this investigation clearly show that rhesus monkeys can acquire information about the solution of an object-quality discrimination problem simply by watching another monkey execute a single trial on the problem. Thus, we have demonstrated that they can acquire some degree of proficiency in observational learning. Doubtless, had the experiment continued, even greater proficiency would have obtained. Moreover, the method used, which involves multiple presentations of simple problems, permits repeated demonstrations of the phenomenon, and is thus useful for further systematic experimental analysis.

What is the nature of *O*'s response on its first test trial? Clearly, *O* is not "imitating" in the "matched-dependent" sense of Miller and Dollard (1941), for *O*'s response does not consistently match (or oppose) *D*'s response nor does it occur simultaneously with it. Also, *O* is not imitating via a mediating process of "identification," as has been proposed by Mowrer (1950) in the case of the "talking" birds, for *O* does not reproduce *D*'s actions and *O* derives no reward from *D*, so essential for the development of the identification. Indeed, *D* frequently competes with *O* for food.

Spence's notion of stimulus enhancement (1937) does not explain *O*'s behavior either, also for the reason that *O* can correct for *D*'s mistakes. Indeed,

O's performance is better if *D* makes a mistake than it would be if *D* made a correct guess. This latter finding is not without precedent (Moss & Harlow, 1946; Riopelle, 1955) and perhaps results from a distracting effect of seeing food. Thus, when *D* obtains food, *O*'s attention is distracted from the critical stimuli. The desirability of witnessing of errors by *O* in a problem-box situation has been emphasized by Herbert and Harsh (1944).

The present experimental arrangement satisfies all the requirements of a nonspatial delayed-response test. Although this test is admittedly of great difficulty, even for chimpanzees, when conducted under the usual procedures (Yerkes & Nissen, 1939), successful performance has been demonstrated previously for rhesus monkeys in an observational-learning situation (Harlow, 1944). Highly successful delayed imitation has been demonstrated by the Hayeses (1952) with their home-raised chimpanzee, Viki.

In the present situation, *O* simply uses *D* as a sign stimulus to denote the object *O* must displace to obtain food. It is interesting to note also that this response satisfies Maier's requirements for a test of reasoning.

SUMMARY

Four monkeys were each given 500 object-quality discrimination problems to solve. Prior to their first trial on each problem they witnessed another monkey execute a single demonstration trial. In the 500 demonstration trials viewed by each observer, exactly half were "correct," i.e., the demonstrator received reward for its selection. The observer was never rewarded on this trial. Its reward came whenever it made a response to the appropriate stimulus object. Appropriateness was defined as a response to the object selected by the demonstrator if the demonstrator had been rewarded or a response to the non-selected object if the demonstrator had received no reward.

All observers showed improvement in their ability to derive information from the observation trial; the observers' first test-trial performance rose from chance level to 75% correct and was still rising at the end of the experiment.

Performance on later trials in the same problems was even higher. It was also found that observational-learning performance was higher if the demonstrator had made a "mistake" than it was if it had made a "correct" response.

The similarity between the procedure of this experiment and that used to test nonspatial delayed response was emphasized.

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The competence of the model and the learning of imitation and nonimitation

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and
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In imitative learning, not only does the learner respond to the cues provided by the behavior of a model but he has available potentially valuable cues in the form of the environmental consequences of the model's response. In their treatment of learning and imitation, Miller and Dollard (1941) consider societal conditions that may facilitate the imitative process, attending especially to the prestige of the models as an important relevant variable. According to their analysis, individuals who have learned to respond independently to environmental cues can, by their behavior, supply relevant cues for the behavior of others for whom the initial environmental cues are obscure, difficult, or not discriminable in some way. Models are regarded as having prestige when the imitation of their behavior consistently leads to a rewarding state of affairs for the imitator.

It is clear that a variety of learned and generalized properties of individuals are valuable clues to prestige, and hence their presence functions to elicit imitative behavior toward a potential model. Miller and Dollard allude to a variety of hierarchies extant in society within which differentiation in prestige is frequently made, i.e., age-grade levels, social status, intelligence, technical knowledge, etc. Underlying many of these dimensions is the availability of knowledge of the environmental competence of a potential model. Competence refers here to the degree to which an individual receives, in reaction to his behavior, evidence of correctness or, more apparently, reward or lack of punishment.

Previous experimental studies of imitation have confounded consistently in their experimental procedures the competence and imitative cues. The model presents his response which is to be matched by the potential imitator and in addition, he is rewarded for his behavior. In such a situation it is not possible to evaluate independently the contribution to the imitative process of the two cues. An exception to this procedural confounding appears only in the work of McDavid (1959) who, when employing adult models for child imitators, did not reward the adults.

By effecting a procedure wherein the imitative cue and the competence

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cue are independent of each other, the competence cue becomes essentially irrelevant to successful performance of *S*. In the present experiments *S* is capable of learning to imitate or nonimitate solely by attending to the model's response. Differential response in relation to cues of the model's competence may therefore be interpreted in terms of the pre-experimental experiences of *S*s.

It is likely, at least in our cultural milieu, that human organisms learn early to differentiate among others in terms of competence and, accordingly, in terms of prospects for successful imitation. Studies dealing with conformity behavior (Kelman, 1950; Mausner, 1954; Mausner & Bloch, 1957) have indicated the relevance of evidence of competence to the responses of an observer. The present study investigates experimentally the hypothesis that learning to imitate competent models will occur more readily than learning to imitate incompetent models. A similar analysis may be applied to non-imitative behavior.

In considering the learning of nonimitation, the most apparent and parsimonious hypothesis is simply the obverse of the imitative hypothesis: that an incompetent model's behavior will lead to responses other than imitating and therefore the learning of nonimitation of an incompetent model will obtain a higher level than the learning of nonimitation of a competent model. A variety of other suggestions may be made in predicting nonimitative response, i.e., the irrelevance of past experience with incompetent models, the tendency to nonimitate competent models who in the past received all the available rewards, and the potential salience of competency over incompetent response. The complexity of these possibilities does not permit specific prediction in the present situation.

EXPERIMENT I

Method

Apparatus.—The apparatus included two response boxes, two signal boards which presented all of the relevant stimuli to each of 2 *S*s, and a master control panel which was used by *E*. A response box was placed on the arm of a student chair in each of the two rooms occupied by the *S*s. It consisted of a double-throw lever switch by means of which each *S* indicated, upon a given signal, a "win" or a "lose" response.

A signal board placed on a table approximately 5 ft. from *S* was also duplicated in each of the two rooms. The signal board consisted of a plywood box 12½ in. wide and 18 in. high, with a depth of 6 in. It was divided into two vertical sections. The top one-third of each of these sections consisted of a compartment containing a 115-v., 7.5-w. frosted lamp, both of which could be turned on and off separately by *E*. The

compartments were covered with milk glass: the left compartment was labeled "A" and the right, "B." The lower two-thirds of each vertical section was divided into two compartments, each of which also contained a 115-v., 7.5-w. frosted lamp. The milk glass covering the upper of these compartments on each side was labeled WIN and the lower compartments were similarly labeled, LOSE. All letters were 1 in. high black plastic. Between the upper one-third and the lower two-thirds of each vertical section there was a green and a red 1-in. jeweled lamp.

Procedure.—A simulated horse-racing situation adapted from that used by Brown, Clarke, and Stein (1958) was employed. Two *Ss* participated in each session and each was informed by a sign on the wall of his individual room that he was Subject B. Each *S* was thereby led to believe that the other *S* was Subject A. The *E*, seated in a third room in front of a central control panel, read instructions into a microphone. The instructions indicated that when a signal lamp designating either A or B was illuminated, the appropriate *S* was to guess the outcome of an imaginary horse race. The *S* was to think of the race as involving his horse running against a field of horses, and his task was to guess whether or not his horse would win or lose the race by moving the response lever appropriately. A and B were to think of their horses as running at all times on different tracks in different parts of the country, and as never competing against each other. The *Ss* were also informed that *E* was interested in the group product as well as individual responses. This information was presented in keeping with the finding by Kanareff and Lanzetta (1958) that imitative behavior is facilitated by instructions implying positive sanctions for matching.

The *S*'s guess would be indicated on the signal board in each of the rooms. The accuracy of his guess would then be shown by the jeweled lamps: illumination of the green lamp indicated a correct response; the red lamp, an incorrect response. A single trial included the races of both A and B. Subject A responded first on each trial. Subject A's win or lose response and the red or green lamp remained illuminated during B's portion of the trial.

The similated responses of A were presented by *E*. In every block of 10 trials half of *A*'s responses were win, and half were lose, in a random pattern. The designation of the correctness of the responses of A was made according to programed schedules which made up the experimental conditions for the differential competence of the model. For one-third of the *Ss*, A was designated correct on 80% of the trials in each block of 10; for one-third A was correct on 50% of the trials; and for one-third A was correct on 20% of the trials.

The designation of the correctness of B's (*S*'s) win or lose response was dependent both on A's response and on the training condition. When imitation was to be trained, a response by *S* which matched that of A was correct. When nonimitation was to be trained, a response by *S* matching that of A was incorrect.

Subjects.—The three levels of the model's competence were pre-

sented in conjunction with each of the training procedures: imitation, and nonimitation. Seventy-two male students (12 *Ss* in each of six conditions) were recruited in pairs from the elementary psychology course. The *Ss* were exposed to 10 blocks of 10 trials, and following these, completed a questionnaire adapted from that employed by Kanareff and Lanzetta (1958) which inquired about various aspects of the experiment.

Results and discussion

The mean frequencies of imitative responses per block of 10 trials for each of the conditions are presented graphically in Figure 4-8. It is apparent that the training conditions were effective in producing differential acquisition of imitative responses. Training for imitation yielded consistently increasing frequencies of imitative responses while decreasing frequencies of imitative responses appear under training for nonimitation.

Summaries of analyses of variance of the data for each of the training conditions are presented in Table 4-6. Under training for imitation, the main effects for Model's Competence and for Trials are significant but the Model's Competence × Trials interaction is not. The significant Trials effect reflects the differential operation of the training procedures.

In order to evaluate the experimental hypothesis for learning of imitation in relation to competence of the model the critical difference technique (Lindquist, 1953) was applied to the means presented in the upper row of Table 4-7. Only the difference between the 80% competence mean and the 20% competence mean is significant. The mean for the 50% competence condition is intermediate. Support is offered for the hypothesis that learning

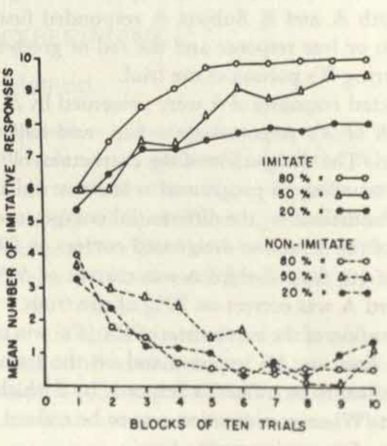

Figure 4-8. Mean number of imitative responses per block of 10 trials in Exp. I.

Table 4-6. Analysis of variance of frequency of imitative responses in each training condition: Exp. I

Source	*df*	Training Conditions			
		Imitation		Nonimitation	
		MS	*F*	*MS*	*F*
Model's competence (MC)	2	87.85	3.99*	9.70	1.00
Error (B)	33	21.99		14.77	
Trials (T)	9	44.36	23.59**	33.99	16.67**
MC × T	18	2.01	1.07	2.16	1.06
Error (W)	297	1.88		2.04	

*$P < .05$.
**$P < .01$.

to imitate a competent model proceeds more rapidly than learning to imitate an incompetent model.

The analysis of the data for training to nonimitate yields a significant Trials effect only. This reflects the decreasing tendency to present imitative responses. The nonsignificant main effect for Model's Competence indicates failure to obtain support for the hypothesis that variations in Model's Competence lead to differential patterns in the learning of nonimitation.

Evaluation of the hypotheses was somewhat handicapped by the apparent ceiling imposed by the structure of the task on continued acceleration of learning in both training conditions. A considerable number of *S*s in each of the experimental conditions reached the maximum of either 100% imitation or 100% nonimitation early in the series of trials. Since the procedure allowed *S* in each of the training conditions to be rewarded on every occasion on which *S* responded correctly for his training condition, the frequency of ceiling level performance suggests a rather too simple task. Reduction of the frequency with which *S* can be correct for performing the response that is being trained may reduce the frequency of ceiling level performance and facilitate comparison of the effect of the Model's Competence conditions. Experiment II was conducted in accord with this suggestion.

Before proceeding to Exp. II, data derived from the postexperimental questionnaire will be considered. Ten questions were asked dealing with *S*'s

Table 4-7. Mean frequency of Imitative Responses in Exp. I

Training Condition	Model's Competence		
	80%	50%	20%
Imitation	9.07[a]	8.13[ab]	7.36[b]
Nonimitation	1.30[c]	1.78[c]	1.26[c]

Note—Means in each row marked with a letter in common do not differ significantly at the .05 level by the critical difference technique (Lindquist, 1953).

Table 4–8. Mean estimates of the percentage of the model's accuracy

Training Condition	Model's Competence		
	80%	50%	20%
Imitation	71.3	48.8	37.1
Nonimitation	63.8	50.0	36.3

expectations for performance, reports of A's and *S*'s own performance, and reports on *S*'s feelings of frustration and competitiveness. In response to the questions, *S* checked a continuous rating scale ranging from 100% to 0%. Only two of the questions resulted in statistically significant differences among the experimental conditions.

The *S* was asked to report on the model's competence in a question reading, "What percentage of his predictions did your partner predict correctly?" The means for the experimental conditions are presented in Table 4–8. Analysis of variance indicated a significant main effect only for the Model's Competence variable. The *Ss*' reports conform in their pattern to the procedural manipulation of the model's correctness although a tendency toward centrality is apparent. The highly competent model is described as less competent than his actual performance and the reverse is reported for the least competent model.

A question asking for a report on percentage of agreement of responses of *S* and the model resulted in significant differences between *Ss* in the different training conditions. The *Ss* trained for imitation reported agreement with their partner on an average of 68.6% of the trials while nonimitation *Ss* reported an average of 20.75% agreement ($F = 55.12$, $P < .001$). The *Ss* are capable of reporting their behavior during the course of the experiment.

EXPERIMENT II

Method

The procedure was identical with that of Exp. I with two modifications. First, for both training conditions, imitation and nonimitation, the maximum frequency of designation of correctness for the prescribed instrumental response was 8 trials of each block of 10 trials. Two trials in each block were chosen at random to be designated as incorrect if the training response was made. Second, because of the possibility that acquisition of the instrumental response would be retarded by the more difficult task, the number of trials was increased from 100 to 150 trials.

The *Ss* were 72 male students (12 *Ss* per condition) in the elementary psychology course, and they served in pairs. Questionnaire data are not available for this experiment.

Results and discussion

Figure 4-9 presents the graphical representation of the mean frequencies of imitative responses per block of 10 trials for each condition. It is apparent that the results are similar to those obtained in Exp. I but clearly altered by the imposition of the modified probability of reinforcement. In contrast to the rather smooth acquisition curves of Exp. I, the learning curves for Exp. II suggest considerable block by block variability.

The training conditions appear again to have resulted in differential acquisition of imitative responses. While the curves obtained under training to imitate tend to ascend, those reflecting training to nonimitate tend to descend. Summaries of the analyses of variance for each of the training conditions appear in Table 4-9.

The results for training to imitate indicate a significant Models × Trials interaction as well as significant main effects for both Models and Trials. The significant interaction term indicates that the three curves differ from each other at least on some of the trials. The critical difference technique applied to the means in the upper row of Table 4-10 (Lindquist, 1953) indicates that both the 80% competence and the 50% competence means differ from the mean for the 20% competence condition but do not differ from each other. Further analysis in the form of the Trials × *Ss* interactions within each

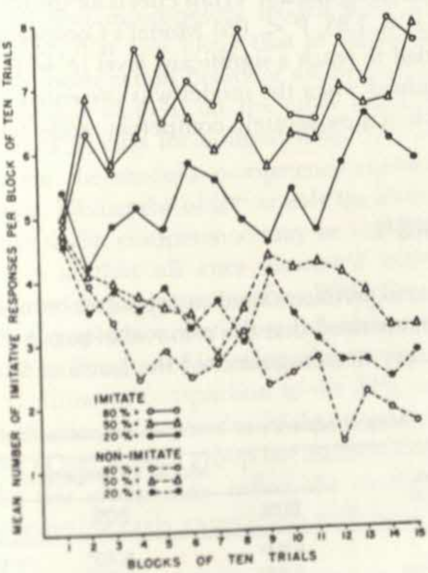

Figure 4-9. Mean number of imitative responses per block of 10 trials in Exp. II.

Table 4-9 Analysis of variance of frequency of imitative responses in each training condition in Exp. II

Source	df	Imitation MS	Imitation F	Nonimitation MS	Nonimitation F
Model's competence (MC)	2	112.03	5.93**	59.57	4.12*
Error (B)	33	18.88		14.47	
Trials	14	12.34	5.04**	11.98	5.62**
MC × T	28	3.98	1.62*	2.90	1.36
Error (W)	462	2.45		2.13	

*p < 0.05. **p < 0.01.

competence treatment group indicates Trials effects ($df = 14/54$) significant at beyond the .01 level for both the 80% ($F = 4.65$) and the 50% ($F = 2.70$) Model's Competence conditions but a nonsignificant effect for the 20% ($F = 1.54$) condition. It appears that learning of imitation occurred under the condition in which the model's competence was high or moderate but not when the competence of the model was low.

The results for training to nonimitate indicate significant main effects both for Model's Competence and for Trials. The interaction of Model's Competence by Trials is not significant. A significant difference is obtained by the critical difference technique (lower row of Table 4-10) only for the comparison between the 80% and the 50% Model's Competence conditions. Trials × *S*s analysis indicates significant Trials effects for the 80% ($F = 6.17$, $P < .01$) and the 20% ($F = 1.83$, $P < .05$) Model's Competence conditions while the 50% group failed to reach a significant level ($F = 1.47$). Learning of nonimitation was obtained when the model was presented as high or low in competence but not when a moderately competent model was offered.

DISCUSSION

The findings of the present experiments tend to support those of Kanareff and Lanzetta (1958) who demonstrated that the removal of negative sanctions for imitating permits laboratory demonstration of the learning of imitation. In

Table 4-10. Mean frequency of Imitative Responses in Exp. II

Training Condition	Model's Competence 80%	50%	20%
Imitation	6.84[a]	6.40[a]	5.31[b]
Nonimitation	2.64[a]	3.79[d]	3.36[cd]

Note—See note to Table 4-7.

contrast to several previous studies (Bush & Mosteller, 1955; Schein, 1954) imitative learning was accomplished by most *S*s participating in the present studies.

The results indicate that in addition to the specific cues relevant to instrumental response acquisition, information revealing the competence of the model affects imitative learning. In order to perform at a maximum level of instrumental correctness in the present experiment, only the information indicating the response choice of the model need have been attended to by *S*s. As in previous experiments on imitative learning, designation of correctness was contingent on whether *S* matched (or did not match in the case of nonimitation) the response of the model. The correctness of the model's response was essentially irrelevant to successful matching but the results indicate that the variations in model's competence were contributory to the acquisition process. This clearly suggests that *S*'s prior social learning history generalized to the present situation.

As suggested by Miller and Dollard (1941) it is likely that early in life, discriminative learning takes place in which situations, models, drives, and other stimuli are differentiated in terms of their instrumental association with imitative behavior. Although, as with other dimensions, differentiation of models may occur for a variety of attributes, most of these connote some degree of environmental competence. Age, brightness, status, skill, are among the attributes suggested by Miller and Dollard (1941).

The effect of early experiences in the learning of nonimitation may involve several complex features. Although an apparent hypothesis is that individuals learn that incompetent models serve as useful guides to nonmatching behavior, it is also likely that in earlier learning experiences the cues provided by incompetent behavior are primarily irrelevant to successful responses. Competent models, on the other hand, in some situations may present rather reliable cues for nonmatching. This will be true especially in situations wherein the model's competence enables him to claim all the available rewards, leaving the observer only the alternative of a nonmatching response. Alternatively, competence may be consistently highlighted during early experiences so that all cues associated with competence are more salient than those related to incompetence. While Exp. I presents no differences among Model's Competence conditions in learning to nonimitate, the data of Exp. II indicate facilitation of learning of nonimitation in the 80% Model's Competence condition in comparison to the 50% condition. A trend in the direction of facilitation of acquisition of the nonimitative response appears for the 20% Model's Competence group but statistical significance is not reached. The results for this group may reflect the conflicting response tendencies based on the competing early experiences with incompetent models that were suggested above.

Kanareff and Lanzetta (1958), Lanzetta & Kanareff (1959), and Niemark and Rosenberg (1959) found that imitative response did not achieve

correspondence with the probability of designation of correctness to which *S*s were exposed. Although in each of the present experiments nonvarying probabilities were employed (100% in Exp. I and 80% in Exp. II), in each case the matching of the probabilities of correctness and imitative response was quite close for several of the experimental groups. In Exp. I under training to imitate, *S*s in the 80% Model's Competence condition imitated during the last five blocks of trials at a level continuously exceeding 98%. On only six of the trials was there failure to match on the part of any *S*s in this group. All but 6 *S*s trained to nonimitate achieved levels of response of nonmatching approximating the probability of correctness. The 6 *S*s were distributed over the three Model's Competence conditions.

In Exp. II coincidence of the instrumental response and probability of correctness was approximated only by *S*s in the 80% Model's Competence conditions. The mean of the last five blocks of trials for those in this condition who were trained to imitate was 7.37, while the corresponding mean for non-imitators was 1.91.

Another finding that is in contrast to results obtained by Kanareff and Lanzetta (1958), Lanzetta & Kanareff (1959), and Niemark and Rosenberg (1959) concerns differential rapidity of learning of imitation and nonimitation. Their results indicate more rapid acquisition of imitation than nonimitation. These findings are not repeated in the present data and, in fact, a trend in the direction of more rapid acquisition of the instrumental response is indicated for the nonimitation condition in the two experiments (cf. Figs. 4-8 and 4-9). This is consistent with Bush and Mosteller's (1955) suggestion that events which increase nonimitation have a greater effect than events that increase imitation.

The present experiments differ in two important ways from previous studies in which conformity behavior or matching has been examined in relation to the competence of the model (Kelman, 1959; Mausner, 1954; Mausner & Bloch, 1957). In the present situation, the course of acquisition of the dependent response was examined in contrast to simple measurement of its current frequency of appearance. In addition, information as to the model's competence was revealed sequentially in the context of serial response rather than as a pre-experimental manipulation.

SUMMARY

The effect of information concerning the competence of a model on learning of imitative and nonimitative behavior was examined in two experiments. The *S*s predicted the outcomes of a series of fictitious horse races after exposure on each trial to the prediction and correctness of the prediction made by a simulated partner. In three conditions

varying the model's competence, the partner was correct on 80%, 50%, or 20% of each block of 10 trials.

In Exp. I, half of the *S*s were trained under conditions wherein they were correct 100% of the time if their predictions matched the response of the partner. The other half of the *S*s were correct on 100% of the trials if they nonmatched the partner's prediction. The procedure allowed independent designation of correctness by specifying that the horse races predicted in each trial were run on separate race tracks. Ten blocks of 10 trials were employed. Under training to imitate, the results indicate that the greater the model's competence, the greater is the facilitation of the learning process. Under training to nonimitate, no differences appeared among the three conditions varying the model's competence. Questionnaire data indicated that *S*s were capable of accurate report of several aspects of the procedure.

Experiment II was designed to avoid a ceiling effect by allowing *S*s to be correct a maximum of 80% of the trials, and the number of trials was extended to 150. The results for training to imitate again indicated that the greater the model's competence, the greater is the facilitation of acquisition of the imitative response. Under training to nonimitate, learning was facilitated when the model's competence was high or low but was poorer when the model's adequacy was mediocre.

The results were discussed as reflecting the effect of prior social learning experiences on current social behavior.

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5

SOCIAL FACILITATION

The previous chapter on imitation and observational learning showed that social stimuli may assume discriminative roles. Chapter 3 demonstrated that these stimuli can also be reinforcers. Social stimuli can have many other, less well-defined effects; the introduction of another organism can either raise or lower the rate of ongoing behavior. Such phenomena have traditionally been studied under the topic of social facilitation.

Social facilitation is one of the oldest topics in the experimental study of social behavior. The first paper included in this chapter, "Social facilitation," by R. B. Zajonc, reviews much of the early literature. Zajonc defines social facilitation as ". . . an increase in an already learned behavior that occurs in the presence of another animal." The study of social facilitation, however, has included examination of the effects not only of social stimuli on the acquisition as well as the maintenance of behavior, but also on suppression, as well as facilitation, of responding.

In the study of social facilitation, only the presence of another organism is added to the experimental situation. No change is made in nonsocial stimuli, schedules of reinforcement, or other variables that initially controlled the responses. Zajonc's classification of social facilitation effects into "audience" and "coaction" effects is frequently used in the literature. In studies dealing with audience effects, the second animal is simply present in the experimental setting with no specific response required; in studies treating coaction effects, the second organism does make a specific, experimentally controlled response, usually the same response as made by the organism whose behavior is under investigation.

The literature reviewed by Zajonc is filled with contradictions. For example, the presence or coaction of a second organism had a facilitative effect on rotary tracking (pursuit rotor), attention, and various other simple behaviors with human subjects, on eating with a variety of organisms, and on nest building with ants. However, the presence or coaction of a second organism

had a suppressive effect on various learning tasks with a variety of organisms, and on apparently more difficult behaviors with human beings.

Zajonc resolves these contradictions by proposing that the effect of social stimuli is to facilitate the "dominant" response, or the response with the "highest probability of occurrence." Responses that have been acquired and are being maintained are therefore facilitated. Responses that are being acquired are thus suppressed, while responses other than the one being acquired are facilitated. Zajonc proposes that the cause of the facilitation is a physiological arousal of the organism produced by the social stimuli.

Concepts such as "arousal" and "dominant response" are difficult to relate to the analysis of behavior. In behavioral analysis, the rate of behavior is related most often to the environmental consequences of that behavior, rather than to an internal physiological state. Moreover, responses are defined, not by "dominance" or some other property of the response itself, but by the interaction of the behavior with the environment. "Probability of response" is a concept that the behavior analyst can accept as scientific because its validity may be tested in an experimental setting. The probability of a response is determined by its past history of stimulus control and reinforcement. A response with a high rate of occurrence in the past under certain reinforcement and discriminative conditions has a high probability of reoccurring at that rate under the same conditions in the future.

If social stimuli do increase the probability of occurrence of the most probable response, they should, for example, facilitate responses made under stimulus conditions that are discriminative for reinforcement of that response, and suppress responding in the presence of a stimuli discriminative for nonreinforcement. These predictions can be checked experimentally. The second paper included in this chapter is, in fact, a study of social facilitation using standard procedures of behavior analysis. Entitled, "Conditioned suppression as a sensitive baseline for social facilitation," the paper is by D. F. Hake, J. Powell, and R. Olsen. Conditioned suppression is a well-known phenomenon in the study of behavior. An animal responding at a high, steady rate for a positive reinforcer is presented a warning stimulus followed, after a short time, by an electric shock. During the period between the warning stimulus and the shock, responding for the reinforcer is reduced to a very low rate. This reduction in the rate is the conditioned suppression. In an earlier study, Hake and Laws (1967) found that the presence of a coactor during the warning period increased the responses that had been suppressed throughout previous warning periods. Or, stated another way, the presence of the coactor reduced the conditioned suppression. The fact that a suppressed, therefore improbable, response was facilitated by social stimuli appears to contradict Zajonc's hypothesis. However, the argument might be raised that the response

that was facilitated, although regarded as improbable, was still the "most probable" response under the conditions of the experiment. These assertions must be examined experimentally and have not been to date.

Two experiments on the social facilitation of suppressed responding are presented by Hake, Powell, and Olsen. In the two experiments, the intensity of the shocks that followed the warning stimulus was varied. At lower shock intensities, conditioned suppression was less, i.e., rate of responding following the warning stimulus was higher than when higher shock intensities were used. The social facilitation effect also was less at lower shock intensities. Thus, the less probable the response became, the greater the facilitation. The results again contradict Zajonc's hypothesis.

As part of the second experiment reported by Hake, Powell, and Olsen, three pigeons were punished during certain periods for responding for food. During these periods responding was, of course, suppressed by the punishment. During the test periods when responses were being punished, a coactor was introduced. For two of the pigeons, no facilitative effect was noted on the suppressed responding. However, for the third pigeon, such an effect did occur. Again a low probability response was facilitated by social stimuli.

Hake, Powell, and Olsen cite internal states of the organisms as one possible explanation for their results. In some instances, according to Hake, *et al.*, the presence of other organisms appeared to reduce the emotional behavior that may have been in competition with the operant behavior under investigation. This explanation conflicts somewhat with Zajonc's theory that arousal contributes to the facilitation of behavior. Another explanation offered by Hake *et al.*, is that the presence of a second responding organism may have become discriminative, from the general past experience of the subjects, for the absence of aversive stimuli. The second organism thus may have functioned as a discriminative stimulus that conflicted with the function of the discriminative stimuli provided by the experimental conditions. The investigators suggest that the organism's past history with imitation, observational, or vicarious learning may contribute to social facilitation. The explanations that refer to observable data are more appealing from the behavioral point of view since they are open to experimental examination. Some effects of social stimuli may not be attributable solely to reinforcement or discrimination; they may, in fact, be connected with an internal state of the organism. However, a more definitive approach than that signified by terms such as "arousal" or "emotional behavior" will be needed if an understanding is to be achieved.

In the final paper included in this chapter, by L. Wheeler and H. Davis and entitled, "Social disruption of performance on a DRL schedule," the effect

of social stimuli on another well-known behavioral performance is examined. "DRL" is an abbreviation of "differential reinforcement of low rate." On a DRL schedule, the animal must separate its responses by a certain period of time in order to obtain reinforcement. If a response occurs too soon after the previous one, a timer resets and the specified amount of time must lapse again before another response resulting in reinforcement can be emitted. DRL schedules are not easy to establish; they appear to be aversive to the organism, and it is difficult to reinforce inactivity. Nevertheless, stable performances on DRL schedules can be maintained.

Wheeler and Davis, after establishing DRL performances in individual rats, added a second rat to the experimental chamber. The addition of the second rat caused an increase in responding and, hence, a decrease in reinforcement for the responding rat. Again, DRL responding is difficult to relate to the concept of a "dominant" response. If the simple bar pressing response is regarded as dominant, then the results are consonant with Zajonc's theory. Social stimuli clearly raised the rate of the already acquired bar pressing response. On the other hand, if the "dominant" response is the bar pressing in combination with the DRL spacing, a behavioral chain that had been acquired by each rat, then the social stimuli depressed that response. Since the second rat was placed in the same chamber with the first, the past histories of the rats in regard to competition may have influenced the rate of responding. In fact, in another paper, Davis and Wheeler (1966) report that rats on a DRL schedule, when coacting with a rat responding on a fixed-ratio schedule, would jealously guard their response lever and food pellets. Although the DRL schedule is probably more aversive and provides less reinforcement than the fixed-ratio schedule, the DRL rat would attack the second rat apparently to protect its opportunity for DRL responding. In the study by Wheeler and Davis presented here, aggression also appeared to influence the rate of response.

The effect of social stimuli on leadership and cooperative responding has been studied with human subjects (Cohen and Lindsley, 1964). These investigators used the apparatus described in Cohen's study of the extra-experimental relationships of a 13-year-old boy (Cohen, 1962), in which a plexiglas partition separated two operant test chambers. The plexiglas could be exposed or covered, making the subjects visible or not visible to each other. In the absence of social stimuli, colored lights indicated the responses and reinforcement of the other subject. Cohen and Lindsley studied the acquisition and maintenance of cooperation and leadership, both with and without the addition of social stimuli. Social stimuli were presented first under the conditions of established cooperative responding with controlled leadership. Although the response had been acquired and was occurring at a high rate, "The human stimulation suppressed responding throughout its duration" (Cohen and

Lindsley, 1964, p. 127). Removal of the stimuli restored responding. During the second such presentation, responding was again suppressed, although not as completely. When human stimuli were added during an attempt to switch controlled leadership from one subject to the other, the change in leadership was facilitated. Thus, social stimuli apparently facilitated the acquisition of a new social relationship. Again, the results conflict with Zajonc's theory that suggests that social stimuli will disrupt acquisition of a response, yet facilitate its maintenance.

Nature does not always cooperate with scientific classifications. Various effects of social stimuli have heretofore been studied under the label of "social facilitation." Worthy attempts such as Zajonc's have been made to find an encompassing explanation for contradictory results. Many interesting phenomena appear to occur simply because another organism is present. To date, the studies in this area have served to pose more questions than they have answered. However, with better control and further experimental study of social phenomena, social facilitation and suppression will probably be traced to the effects of generalization from past experience with social reinforcement, cooperation, competition, and observational learning. Social phenomena such as those examined in this chapter have a fascination that comes from their almost magical effect. An understanding of these phenomena would allow the specification of the social stimulus conditions that would facilitate, for example, learning in school settings, or productivity in work settings. The social conditions that would minimize the occurrence of undesired behaviors could be clarified. Although a simple theory does not appear to suffice, the necessary understanding can, and most probably will be achieved.

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Social facilitation

Robert B. Zajonc

Most textbook definitions of social psychology involve considerations about the influence of man upon man, or, more generally, of individual upon individual. And most of them, explicitly or implicitly, commit the main efforts of social psychology to the problem of how and why the *behavior* of one individual affects the behavior of another. The influences of individuals on each others' behavior which are of interest to social psychologists today take on very complex forms. Often they involve vast networks of interindividual effects, such as one finds in studying the process of group decision-making, competition, or conformity to a group norm. But the fundamental forms of interindividual influence are represented by the oldest experimental paradigm of social psychology: social facilitation. This paradigm, dating back to Triplett's original experiments on pacing and competition, carried out in 1897 (*1*), examines the consequences upon behavior which derive from the sheer presence of other individuals.

Until the late 1930's, interest in social facilitation was quite active, but with the outbreak of World War II it suddenly died. And it is truly regrettable that it died, because the basic questions about social facilitation—its dynamics and its causes—which are in effect the basic questions of social psychology, were never solved. It is with these questions that this article is concerned. I first examine past results in this nearly completely abandoned area of research and then suggest a general hypothesis which might explain them.

Research in the area of social facilitation may be classified in terms of two experimental paradigms: audience effects and co-action effects. The first experimental paradigm involves the observation of behavior when it occurs in the presence of passive spectators. The second examines behavior when it occurs in the presence of other individuals also engaged in the same activity. We shall consider past literature in these two areas separately.

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AUDIENCE EFFECTS

Simple motor responses are particularly sensitive to social facilitation effects. In 1925 Travis (*2*) obtained such effects in a study in which he used the pursuit-rotor task. In this task the subject is required to follow a small revolving target by means of a stylus which he holds in his hand. If the stylus is even momentarily off target during a revolution, the revolution counts as an error. First each subject was trained for several consecutive days until his performance reached a stable level. One day after the conclusion of the training the subject was called to the laboratory, given five trials alone, and then ten trials in the presence of from four to eight upper-classmen and graduate students. They had been asked by the experimenter to watch the subject quietly and attentively. Travis found a clear improvement in performance when his subjects were confronted with an audience. Their accuracy on the ten trials before an audience was greater than on any ten previous trials, including those on which they had scored highest.

A considerably greater improvement in performance was recently obtained in a somewhat different setting and on a different task (*3*). Each subject (all were National Guard trainees) was placed in a separate booth. He was seated in front of a panel outfitted with 20 red lamps in a circle. The lamps on this panel light in a clockwise sequence at 12 revolutions per minute. At random intervals one or another light fails to go on in its proper sequence. On the average there are 24 such failures per hour. The subject's task is to signal whenever a light fails to go on. After 20 minutes of intensive training, followed by a short rest, the National Guard trainees monitored the light panels for 135 minutes. Subjects in one group performed their task alone. Subjects in another group were told that from time to time a lieutenant colonel or a master sergeant would visit them in the booth to observe their performance. These visits actually took place about four times during the experimental session. There was no doubt about the results. The accuracy of the supervised subjects was on the average 34 percent higher than the accuracy of the trainees working in isolation, and toward the end of the experimental session the accuracy of the supervised subjects was more than twice as high as that of the subjects working in isolation. Those expecting to be visited by a superior missed, during the last experimental period, 20 percent of the light failures, while those expecting no such visits missed 64 percent of the failures.

Dashiell, who, in the early 1930's, carried out an extensive program of research on social facilitation, also found considerable improvement in performance due to audience effects on such tasks as simple multiplication or word association (*4*). But, as is the case in many other areas, negative audience effects were also found. In 1933 Pessin asked college students to learn lists of nonsense syllables under two conditions, alone and in the presence of several

spectators (*5*). When confronted with an audience, his subjects required an average of 11.27 trials to learn a seven-item list. When working alone they needed only 9.85 trials. The average number of errors made in the "audience" condition was considerably higher than the number in the "alone" condition. In 1931 Husband found that the presence of spectators interferes with the learning of a finger maze (*6*), and in 1933 Pessin and Husband (*7*) confirmed Husband's results. The number of trials which the isolated subjects required for learning the finger maze was 17.1. Subjects confronted with spectators, however, required 19.1 trials. The average number of errors for the isolated subjects was 33.7; the number for those working in the presence of an audience was 40.5.

The results thus far reviewed seem to contradict one another. On a pursuit-rotor task Travis found that the presence of an audience improves performance. The learning of nonsense syllables and maze learning, however, seem to be inhibited by the presence of an audience, as shown by Pessin's experiment. The picture is further complicated by the fact that when Pessin's subjects were asked, several days later, to recall the nonsense syllables they had learned, a reversal was found. The subjects who tried to recall the lists in the presence of spectators did considerably better than those who tried to recall them alone. Why are the learning of nonsense syllables and maze learning inhibited by the presence of spectators? And why, on the other hand, does performance on a pursuit-rotor, word-association, multiplication, or a vigilance task improve in the presence of others?

There is just one, rather subtle, consistency in the above results. It would appear that the emission of well-learned responses is facilitated by the presence of spectators, while the acquisition of new responses is impaired. To put the statement in conventional psychological language, performance is facilitated and learning is impaired by the presence of spectators.

This tentative generalization can be reformulated so that different features of the problem are placed into focus. During the early stages of learning, especially of the type involved in social facilitation studies, the subject's responses are mostly the wrong ones. A person learning a finger maze, or a person learning a list of nonsense syllables, emits more wrong responses than right ones in the early stages of training. Most learning experiments continue until he ceases to make mistakes—until his performance is perfect. It may be said, therefore, that during training it is primarily the wrong responses which are dominant and strong; they are the ones which have the highest probability of occurrence. But after the individual has mastered the task, correct responses necessarily gain ascendency in his task-relevant behavioral repertoire. Now they are the ones which are more probable—in other words, dominant. Our tentative generalization may now be simplified: audience enhances the emission of dominant responses. If the dominant responses are the correct ones, as is the case upon achieving mastery, the presence of an audience will be of benefit to the individual. But if they are

mostly wrong, as is the case in the early stages of learning, then these wrong responses will be enhanced in the presence of an audience, and the emission of correct responses will be postponed or prevented.

There is a class of psychological processes which are known to enhance the emission of dominant responses. They are subsumed under the concepts of drive, arousal, and activation (*8*). If we could show that the presence of an audience has arousal consequences for the subject, we would be a step further along in trying to arrange the results of social-facilitation experiments into a neater package. But let us first consider another set of experimental findings.

CO-ACTION EFFECTS

The experimental paradigm of co-action is somewhat more complex than the paradigm involved in the study of audience effects. Here we observe individuals all simultaneously engaged in the same activity and in full view of each other. One of the clearest effects of such simultaneous action, or co-action, is found in eating behavior. It is well known that animals simply eat more in the presence of others. For instance, Bayer had chickens eat from a pile of wheat to their full satisfaction (*9*). He waited some time to be absolutely sure that his subject would eat no more, and then brought in a companion chicken who had not eaten for 24 hours. Upon the introduction of the hungry co-actor, the apparently sated chicken ate two-thirds again as much grain as it had already eaten. Recent work by Tolman and Wilson fully substantiates these results (*10*). In an extensive study of social-facilitation effects among albino rats, Harlow found dramatic increases in eating (*11*). In one of his experiments, for instance, the rats, shortly after weaning, were matched in pairs for weight. They were then fed alone and in pairs on alternate days. Figure 5-1 shows his results. It is clear that considerably more food was consumed by

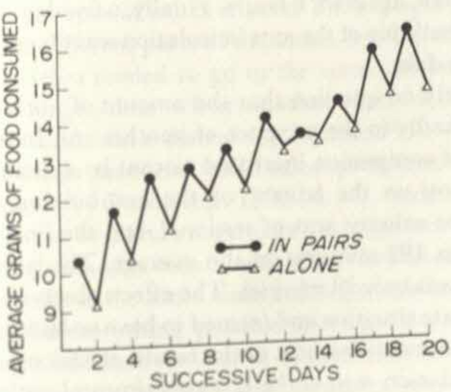

Figure 5-1. Data on feeding of isolated and paired rats. [Harlow (*11*)].

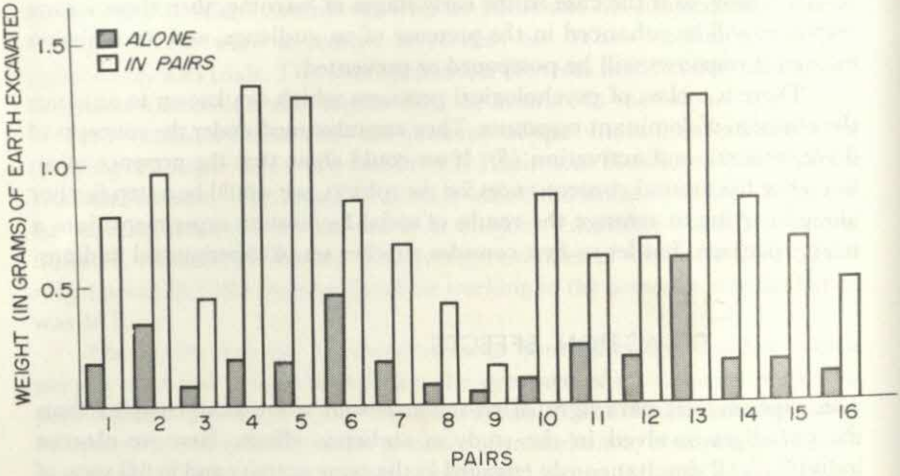

Figure 5–2. Data on nest-building behavior of isolated and paired ants. [Chen (*13*)].

the animals when they were in pairs than when they were fed alone. James (*12*), too, found very clear evidence of increased eating among puppies fed in groups.

Perhaps the most dramatic effect of co-action is reported by Chen (*13*). Chen observed groups of ants working alone, in groups of two, and in groups of three. Each ant was observed under various conditions. In the first experimental session each ant was placed in a bottle half filled with sandy soil. The ant was observed for 6 hours. The time at which nest-building began was noted, and the earth excavated by the insect was carefully weighed. Two days afterward the same ants were placed in freshly filled bottles in pairs, and the same observations were made. A few days later the ants were placed in the bottles in groups of three, again for 6 hours. Finally, a few days after the test in groups of three, nest-building of the ants in isolation was observed. Figure 5–2 shows some of Chen's data.

There is absolutely no question that the amount of work an ant accomplishes increases markedly in the presence of another ant. In all pairs except one, the presence of a companion increased output by a factor of at least 2. The effect of co-action on the latency of the nest-building behavior was equally dramatic. The solitary ants of session 1 and the final session began working on the nest in 192 minutes, on the average. The latency period for ants in groups of two was only 28 minutes. The effects observed by Chen were limited to the immediate situation and seemed to have no lasting consequences for the ants. There were no differences in the results of session 1, during which the ants worked in isolation, and of the last experimental session, where they again worked in solitude.

If one assumes that under the conditions of Chen's experiment nest-building *is* the dominant response, then there is no reason why his findings could not be embraced by the generalization just proposed. Nest-building is a response which Chen's ants have fully mastered. Certainly, it is something that a mature ant need not learn. And this is simply an instance where the generalization that the presence of others enhances the emission of dominant and well-developed responses holds.

If the process involved in audience effects is also involved in co-action effects, then learning should be inhibited in the presence of other learners. Let us examine some literature in this field. Klopfer (*14*) observed greenfinches—in isolation and in heterosexual pairs—which were learning to discriminate between sources of palatable and of unpalatable food. And, as one would by now expect, his birds learned this discrimination task considerably more efficiently when working alone. I hasten to add that the subject's sexual interests cannot be held responsible for the inhibition of learning in the paired birds. Allee and Masure, using Australian parakeets, obtained the same result for homosexual pairs as well (*15*). The speed of learning was considerably greater for the isolated birds than for the paired birds, regardless of whether the birds were of the same sex or of the opposite sex.

Similar results are found with cockroaches. Gates and Allee (*16*) compared data for cockroaches learning a maze in isolation, in groups of two, and in groups of three. They used an E-shaped maze. Its three runways, made of galvanized sheet metal, were suspended in a pan of water. At the end of the center runway was a dark bottle into which the photophobic cockroaches could escape from the noxious light. The results, in terms of time required to reach the bottle, are shown in Figure 5-3. It is clear from the data that the solitary cockroaches required considerably less time to learn the maze than the grouped animals. Gates and Allee believe that the group situation produced inhibition. They add, however (*16*, p. 357): "The nature of these inhibiting forces is speculative, but the fact of some sort of group interference is obvious. The presence of other roaches did not operate to change greatly the movements to different parts of the maze, but did result in increased time per trial. The roaches tended to go to the corner or end of the runway and remain there a longer time when another roach was present than when alone; the other roach was a distracting stimulus."

The experiments on social facilitation performed by Floyd Allport in 1920 and continued by Dashiell in 1930 (*4*, *17*), both of whom used human subjects, are the ones best known. Allport's subjects worked either in separate cubicles or sitting around a common table. When working in isolation they did the various tasks at the same time and were monitored by common time signals. Allport did everything possible to reduce the tendency to compete. The subjects were told that the results of their tests would not be compared and would not be shown to other staff members, and that they themselves should refrain from making any such comparisons.

Among the tasks used were the following: chain word association, vowel cancellation, reversible perspective, multiplication, problem solving, and judgments of odors and weights. The results of Allport's experiments are well known: in all but the problem-solving and judgments test, performance was better in groups than in the "alone" condition. How do these results fit our generalization? Word association, multiplication, the cancellation of vowels, and the reversal of the perceived orientation of an ambiguous figure all involve responses which are well established. They are responses which are either very well learned or under a very strong influence of the stimulus, as in the word-association task or the reversible-perspective test. The problem-solving test consists of disproving arguments of ancient philosophers. In contrast to the other tests, it does not involve well-learned responses. On the contrary, the probability of wrong (that is, logically incorrect) responses on tasks of this sort is rather high; in other words, wrong responses are dominant. Of interest, however, is the finding that while intellectual work suffered in the group situation, sheer output of words was increased. When working together, Allport's subjects tended consistently to write more. Therefore, the generalization proposed in the previous section can again be applied: if the presence of others raises the probability of dominant responses, and if strong (and many) incorrect response tendencies prevail, then the presence of others can only be detrimental to performance. The results of the judgment tests have little bearing on the present argument, since Allport gives no accuracy figures for evaluating performance. The data reported only show that the presence of others was associated with the avoidance of extreme judgments.

In 1928 Travis (*18*), whose work on the pursuit rotor I have already noted, repeated Allport's chain-word-association experiment. In contrast to Allport's results, Travis found that the presence of others decreased performance. The number of associations given by his subjects was greater when they worked in isolation. It is very significant, however, that Travis used stutterers as his subjects. In a way, stuttering is a manifestation of a struggle between conflicting response tendencies, all of which are strong and all of which compete for expression. The stutterer, momentarily hung up in the middle of a sentence, waits for the correct response to reach full ascendancy. He stammers because other competing tendencies are dominant at that moment. It is reasonable to assume that, to the extent that the verbal habits of a stutterer are characterized by conflicting response tendencies, the presence of others, by enhancing each of these response tendencies, simply heightens his conflict. Performance is thus impaired.

AVOIDANCE LEARNING

In two experiments on the learning of avoidance responses the performances of solitary and grouped subjects were compared. In one, rats were used; in the other, humans.

Let us first consider the results of the rat experiment, by Rasmussen (*19*). A number of albino rats, all litter mates, were deprived of water for 48 hours. The apparatus consisted of a box containing a dish of drinking water. The floor of the box was made of a metal grille wired to one pole of an electric circuit. A wire inserted in the water in the dish was connected to the other pole of the circuit. Thirsty rats were placed in the box alone and in groups of three. They were allowed to drink for 5 seconds with the circuit open. Following this period the shock circuit remained closed, and each time the rat touched the water he received a painful shock. Observations were made on the number of times the rats approached the water dish. The results of this experiment showed that the solitary rats learned to avoid the dish considerably sooner than the grouped animals did. The rats that were in groups of three attempted to drink twice as often as the solitary rats did, and suffered considerably more shock than the solitary subjects.

Let us examine Rasmussen's results somewhat more closely. For purposes of analysis let us assume that there are just two critical responses involved: drinking, and avoidance of contact with water. They are clearly incompatible. But drinking, we may further assume, is the dominant response, and, like eating or any other dominant response, it is enhanced by the presence of others. The animal is therefore prevented, by the facilitation of drinking which derives from the presence of others, from acquiring the appropriate avoidance response.

The second of the two studies is quite recent and was carried out by Ader and Tatum (*20*). They devised the following situation with which they confronted their subjects, all medical students. Each subject is told on arrival that he will be taken to another room and seated in a chair, and that electrodes will be attached to his leg. He is instructed not to get up from the chair and not to touch the electrodes. He is also told not to smoke or vocalize, and is told that the experimenter will be in the next room. That is all he is told. The subjects are observed either alone or in pairs. In the former case the subject is brought to the room and seated at a table equipped with a red button which is connected to an electric circuit. Electrodes, by means of which electric shock can be administered, are attached to the calf of one leg. After the electrodes are attached, the experimenter leaves the room. From now on the subject will receive ½ second of electric shock every 10 seconds unless he presses the red button. Each press of the button delays the shock by 10 seconds. Thus, if he is to avoid shock, he must press the button at least once every 10 seconds. It should be noted that no information was given him about the function of the experiment. No essential differences are introduced when subjects are brought to the room in pairs. Both are seated at the table and both become part of the shock circuit. The response of either subject delays the shock for both.

The avoidance response is considered to have been acquired when the subject (or pair of subjects) receives less than six shocks in a period of 5 minutes. Ader and Tatum report that the isolated students required, on the average, 11

minutes, 35 seconds to reach this criterion of learning. Of the 12 pairs which participated in the experiment, only two reached this criterion. One of them required 46 minutes, 40 seconds; the other, 68 minutes, 40 seconds! Ader and Tatum offer no explanation for their curious results. But there is no reason why we should not treat them in terms of the generalization proposed above. We are dealing here with a learning task, and the fact that the subjects are learning to avoid shock by pressing a red button does not introduce particular problems. They are confronted with an ambiguous task, and told nothing about the button. Pressing the button is simply not the dominant response in this situation. However, escaping is. Ader and Tatum report that eight of the 36 subjects walked out in the middle of the experiment.

One aspect of Ader and Tatum's results is especially worth noting. Once having learned the appropriate avoidance response, the individual subjects responded at considerably lower rates than the paired subjects. When we consider only those subjects who achieved the learning criterion and only those responses which occurred *after* criterion had been reached, we find that the response rates of the individual subjects were in all but one case lower than the response rates of the grouped subjects. This result further confirms the generalization that, while learning is impaired by the presence of others, the performance of learned responses is enhanced.

These are experiments which show that learning is enhanced by the presence of other learners (*21*), but in all these experiments, as far as I can tell, it was possible for the subject to *observe* the critical responses of other subjects, and to determine when he was correct and when incorrect. In none, therefore, has the co-action paradigm been employed in its pure form. That paradigm involves the presence of others, and nothing else. It requires that these others not be able to provide the subject with cues or information as to appropriate behavior. If other learners can supply the critical individual with such cues, we are dealing not with the problem of co-action but with the problem of imitation or vicarious learning.

THE PRESENCE OF OTHERS AS A SOURCE OF AROUSAL

The results I have discussed thus far lead to one generalization and to one hypothesis. The generalization which organizes these results is that the presence of others, as spectators or as co-actors, enhances the emission of dominant responses. We also know from extensive research literature that arousal, activation, or drive all have as a consequence the enhancement of dominant responses (*22*). We now need to examine the hypothesis that the presence of others increases the individual's general arousal or drive level.

The evidence which bears on the relationship between the presence of others and arousal is, unfortunately, only indirect. But there is some very

suggestive evidence in one area of research. One of the more reliable indicators of arousal and drive is the activity of the endocrine systems in general, and of the adrenal cortex in particular. Adrenocortical functions are extremely sensitive to changes in emotional arousal, and it has been known for some time that organisms subjected to prolonged stress are likely to manifest substantial adrenocortical hypertrophy (*23*). Recent work (*24*) has shown that the main biochemical component of the adrenocortical output is hydrocortisone (17-hydroxycorticosterone). Psychiatric patients characterized by anxiety states, for instance, show elevated plasma levels of hydrocortisone (*25*). Mason, Brady, and Sidman (*26*) have recently trained monkeys to press a lever for food and have given these animals unavoidable electric shocks, all preceded by warning signals. This procedure led to elevated hydrocortisone levels; the levels returned to normal within 1 hour after the end of the experimental session. This "anxiety" reaction can apparently be attenuated if the animal is given repeated doses of reserpine 1 day before the experimental session (*27*). Sidman's conditioned avoidance schedule also results in raising the hydrocortisone levels by a factor of 2 to 4 (*26*). In this schedule the animal receives an electric shock every 20 seconds without warning, unless he presses a lever. Each press delays the shock for 20 seconds.

While there is a fair amount of evidence that adrenocortical activity is a reliable symptom of arousal, similar endocrine manifestations were found to be associated with increased population density (*28*). Crowded mice, for instance, showed increased amphetamine toxicity—that is, susceptibility to

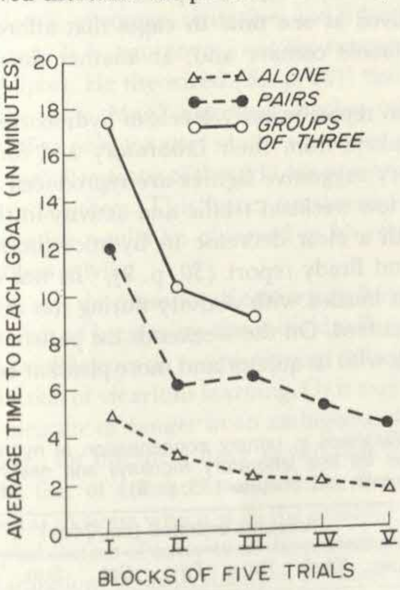

Figure 5-3. Data on maze learning in isolated and grouped cockroaches. [Gates and Allee (*16*)]

Table 5-1. Basal plasma concentrations of 17-hydroxycorticosterone in monkeys housed alone (cages in separate rooms), then in a room with other monkeys (cages in same room). [Leiderman and Shapiro (*35*, p. 7)]

Subject	Time	Conc. of 17-hydroxycorticosterone in caged monkeys (μg per 100 ml of plasma): In separate rooms	In same room
M-1	9 a.m.	23	34
M-1	3 p.m.	16	27
M-2	9 a.m.	28	34
M-2	3 p.m.	19	23
M-3	9 a.m.	32	38
M-3	3 p.m.	23	31
Mean	9 a.m.	28	35
Mean	3 p.m.	19	27

the excitatory effects of amphetamine—against which they can be protected by the administration of phenobarbital, chlorpromazine, or reserpine (*29*). Mason and Brady (*30*) have recently reported that monkeys caged together had considerably higher plasma levels of hydrocortisone than monkeys housed in individual cages. Thiessen (*31*) found increases in adrenal weights in mice housed in groups of 10 and 20 as compared with mice housed alone. The mere presence of other animals in the same room, but in separate cages, was also found to produce elevated levels of hydrocortisone. Table 5-1, taken from a report by Mason and Brady (*30*), shows plasma levels of hydrocortisone for three animals which lived at one time in cages that afforded them the possibility of visual and tactile contact and, at another time, in separate rooms.

Mason and Brady also report urinary levels of hydrocortisone, by days of the week, for five monkeys from their laboratory and for one human hospital patient. These very suggestive figures are reproduced in Table 5-2 (*30*). In the monkeys, the low weekend traffic and activity in the laboratory seem to be associated with a clear decrease in hydrocortisone. As for the hospital patient, Mason and Brady report (*30*, p. 8), "he was confined to a thoracic surgery ward that bustled with activity during the weekdays when surgery and admissions occurred. On the weekends the patient retired to the nearby Red Cross building, with its quieter and more pleasant environment."

Table 5-2. Variations in urinary concentration of hydrocortisone over a 9-day period for five laboratory monkeys and one human hospital patient. [Leiderman and Shapiro (*35*, p. 8)]

Subjects	Amounts excreted (mg/24 hr): Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.	Mon.	Tues.
Monkeys	1.88	1.71	1.60	1.52	1.70	1.16	1.17	1.88	
Patient		5.9	6.5	4.5	5.7	3.3	3.9	6.0	5.2

Admittedly, the evidence that the mere presence of others raises the arousal level is indirect and scanty. And, as a matter of fact, some work seems to suggest that there are conditions, such as stress, under which the presence of others may lower the animal's arousal level. Bovard (*32*), for instance, hypothesized that the presence of another member of the same species may protect the individual under stress by inhibiting the activity of the posterior hypothalamic centers which trigger the pituitary adrenal cortical and sympathetico-adrenal medullary responses to stress. Evidence for Bovard's hypothesis, however, is as indirect as evidence for the one which predicts arousal as a consequence of the presence of others, and even more scanty.

SUMMARY AND CONCLUSION

If one were to draw one practical suggestion from the review of the social-facilitation effects which are summarized in this article he would advise the student to study all alone, preferably in an isolated cubicle, and to arrange to take his examinations in the company of many other students, on stage, and in the presence of a large audience. The results of his examination would be beyond his wildest expectations, provided, of course, he had learned his material quite thoroughly.

I have tried in this article to pull together the early, almost forgotten work on social facilitation, and to explain the seemingly conflicting results. This explanation is, of course, tentative, and it has never been put to a direct experimental test. It is, moreover, not far removed from the one originally proposed by Allport. He theorized (*33*, p. 261) that "the sights and sounds of others doing the same thing" augment ongoing responses. Allport, however, proposed this effect only for *overt* motor responses, assuming (*33*, p. 274) that "*intellectual* or *implicit responses* of thought are hampered rather than facilitated" by the presence of others. This latter conclusion was probably suggested to him by the negative results he observed in his research on the effects of co-action on problem solving.

Needless to say, the presence of others may have effects considerably more complex than that of increasing the individual's arousal level. The presence of others may provide cues as to appropriate or inappropriate responses, as in the case of imitation or vicarious learning. Or it may supply the individual with cues as to the measure of danger in an ambiguous or stressful situation. Davitz and Mason (*34*), for instance, have shown that the presence of an unafraid rat reduces the fear of another rat in stress. Bovard (*32*) believes that the calming of the rat in stress which is in the presence of an unafraid companion is mediated by inhibition of activity of the posterior hypothalamus. But in their experimental situations (that is, the open field test) the possibility that cues for appropriate escape or avoidance responses are provided by the co-actor is not ruled out. We might therefore be dealing not with the effects of the mere

presence of others but with the considerably more complex case of imitation. The animal may not be calming *because* of his companion's presence. He may be calming *after* having copied his companion's attempted escape responses. The paradigm which I have examined in this article pertains only to the effects of the mere presence of others, and to the consequences for the arousal level. The exact parameters involved in social facilitation still must be specified.

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Conditioned suppression as a sensitive baseline for social facilitation

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and
R. Olsen

Social facilitation refers to an increase in an already learned behavior that occurs in the presence of another animal. The term includes increases in behavior that occur in the presence of another animal engaged in the same behavior, a "co-action effect", as well as increases in behavior that occur in the mere presence of another animal, an "audience effect" (Zajonc, 1965). Feeding, the behavior most frequently studied, has been socially facilitated in many species under conditions of food satiation as well as food deprivation (see reviews by Crawford, 1939; Smith and Ross, 1952; Zajonc, 1965; Tolman, 1968). A recent study showed that behavior suppressed by electric shock can also be socially facilitated (Hake and Laws, 1967). That study employed a conditioned suppression procedure (Estes and Skinner, 1941) in which the

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key pecking of pigeons maintained on a variable-interval schedule of food reinforcement was suppressed during the occasional presentation of a warning stimulus paired with electric shock. The presence of a co-actor emitting the same food-reinforced key peck reduced the suppression that otherwise occurred during the warning stimulus when the co-actor was absent.

There are two lines of evidence that predict a larger social facilitation effect when responding is suppressed by aversive stimulation than when it is not. The first concerns the sensitivity of a baseline that is suppressed by aversive stimulation. Previous studies of conditioned suppression and punishment indicate that the changes in non-social variables such as food deprivation (Dinsmoor, 1952; Azrin, 1960; Azrin, Holz, and Hake, 1963) and frequency of reinforcement (Lyon, 1963; Church and Raymond, 1967) produce proportionately larger changes in responding when the responding is suppressed by electric shock than when it is not. Such findings raise the possibility that responding that is suppressed by aversive stimulation may be an unusually sensitive baseline for a number of variables, including social stimuli. The sizable and durable social effect observed by Hake and Laws (1967) may have been due in part to the fact that responding was suppressed by electric shock. Experiment I evaluated this possibility by following the procedure of Hake and Laws (1967) and by comparing social facilitation effects before introduction of shock and at different shock intensities.

The second line of evidence that predicts a larger social facilitation effect when responding is suppressed by aversive stimulation concerns a special relationship between social stimuli and aversive stimuli. Several studies have shown that the presence of another animal can reduce emotional behaviors (Liddell, 1964; Harlow and Zimmerman, 1959; Hoffman, Searle, Toffey, and Kozma, 1966). Liddell (1964) found that the presence of a mother goat prevented experimental neurosis in kids subjected to respondent conditioning. Harlow and Zimmerman (1959) found that the presence of a cloth surrogate mother reduced indicators of emotionality in infant monkeys during the presentation of novel stimuli. Hoffman *et al.* (1966) found that the distress calls of ducklings were reduced in the presence of an imprinting object. It follows that the potential for reducing emotional behaviors should be greater during aversive stimulation than in the absence of aversive stimulation. To the extent that emotional responses interfere with ongoing operants, a reduction in emotional responses should allow ongoing operants to increase. The special history of experience with the social stimulus and the age of the subjects may have been critical to the above mentioned social effects, but it is also possible that such effects may generalize to other members of the same species and endure over time. Experiment II attempted to determine whether the social facilitation effect obtained during the conditioned suppression procedure using adult pigeons with no prior relationship could be attributed to the mere presence of the co-actor.

EXPERIMENT I

Subjects and Apparatus. Twenty adult male White Carneaux pigeons were maintained at about 80% of free-feeding body weight; 10 served as subjects and 10 as co-actors. Two subjects (2 and 3) had previously served in a conditioned suppression experiment in which responding had been socially facilitated at a single shock intensity. All subjects and co-actors had a separate living cage but there was no attempt to control visual or auditory observation of other pigeons.

The experimental space, which was inside a sound-attenuating and light-proof box, consisted of two 18-cm wide by 36-cm long compartments separated by a transparent partition. The partition allowed the subject continuous visual and auditory observation of the co-actor's compartment but prevented physical competition over food. Both compartments had a key, a 1.9-cm diameter illuminated disc, and a feeding mechanism located on the same front wall so that the two separated animals worked alongside each other. In both compartments, a peck of 10 g or more on the response key defined a response; reinforcement was a 3-sec presentation of a grain mixture that could be reached when the bird put its head into a wall aperture. During reinforcement an overhead light and the key light were extinguished and the aperture was illuminated by 2-w lights. The warning stimulus was a change from white to red or green illumination of both response keys and the electric shock delivered at the end of the warning stimulus was a 100-msec ac shock. The ac shock, specified as the voltage at the secondary of a step-up transformer, was delivered through a 10K series resistor to electrodes in the tail region of the subject (Azrin, 1959). Since the resistance of the subject was approximately 1000 ohms, each 10 v was equivalent to about 1 ma of current flow through the subject. The co-actor did not receive shock.

Procedure. For the subjects, food reinforcements were scheduled according to a 1-min variable-interval (VI 1-min) schedule. A 2-min warning stimulus (1.5 min for Subjects 2 and 3) was presented four times per session (three times for subjects 2 and 3) at irregular intervals of time averaging 15 min apart. One VI 1-min reinforcement tape operated during the warning stimulus and another identical tape operated during the safe stimulus so that reinforcements which became available during the warning stimulus but were not obtained were available upon the next presentation of the warning stimulus. This minimized any possible difference in reinforcement frequency between the two components that might result from suppression during the warning stimulus.

The subjects were exposed to this procedure without shock in daily 1-hr sessions (45 min for Subjects 2 and 3) for at least a month. Then, the co-actor

was introduced during alternate sessions. For the co-actor, each key peck during the warning stimulus was followed by food reinforcement; responses during the safe stimulus (absence of warning stimulus) were not reinforced. The shock was then introduced at the end of the warning stimulus and gradually increased in intensity over sessions so each subject was given several different levels of suppression, including nearly complete suppression. A given shock intensity was in effect until there was no consistent change in the response rate during the warning stimulus but a minimum of eight sessions, four with the co-actor present and four with the co-actor absent, was provided at each intensity. More sessions were provided at the highest shock intensity in order to assess the consistency and durability of the social facilitation effect. After the highest shock intensity, four subjects (3, 4, 5, and 8) were returned to 0 v for 30 sessions.

Results

Figure 5-4 shows the response rate during the warning stimulus as a function of shock intensity. Sessions with the co-actor present are indicated by the solid circles and sessions with the co-actor absent are indicated by the open circles. It can be seen that: (1) response rates decreased as a function of shock intensity whether the co-actor was present or absent; but, (2) at the highest shock intensities there was less suppression when the co-actor was present. With the exception of Subjects 3 and 9, there was little or no social facilitation before shock was introduced. This was also the case at some of the lower shock intensities. However, all subjects showed a social facilitation effect at the highest shock intensity and most subjects had a consistent social facilitation effect at several of the higher shock intensities. The consistency of the social facilitation effect at the highest intensity is indicated by the finding that in 179 of the 185 sessions, with the co-actor present at the highest shock intensity, the response rate was higher than during both the preceding or subsequent sessions with the co-actor absent. The larger social facilitation effect at the higher shock intensities cannot be attributed to the fact that the animals had been tested together for a longer period of time, since the effect was either greatly reduced or eliminated for the four subjects that were returned to 0 v Subjects 3, 4, 5, and 8).

It should be pointed out that for two subjects (4 and 5) social facilitation did not result during the first intensity function (not shown). However, when a second intensity function was run with a different co-actor, a social facilitation effect was observed. The results of these two subjects suggest that some as-yet-unspecified aspect of the individual co-actor is an important variable in social facilitation.

The data of Figure 5-4 have been replotted in Figure 5-5 which shows social facilitation as a function of the amount of response suppression obtained at each shock intensity. Response suppression was expressed as the per cent

reduction in the pre-shock (0 v) response rate and was calculated as follows:

$$\text{per cent suppression} = 100 \left\{ 1 - \frac{\text{resp/min during the warning stimulus at a given shock intensity, co-actor absent}}{\text{resp/min during the warning stimulus at 0 v, co-actor absent}} \right\}$$

Hence, each point in Figure 5-5 represents the degree of response suppression for a given subject for the sessions that the co-actor was absent at a given shock intensity. Social facilitation has been expressed as the sign difference in response rates between the sessions at a given shock intensity when the co-actor was present and when the co-actor was absent. Thus, points above zero indicate social facilitation while points below zero indicate a higher response rate when the co-actor was absent. Figure 5-5 shows that social facilitation occurred only part of the time at shock levels that produced less than 30% suppression but that it occurred consistently when shock produced over 40% suppression.

Figure 5-6 shows the response rate during the safe stimulus as a function of shock intensity. The safe stimulus response rates represent the response rate for the entire session time in the absence of the warning stimulus. First, consider Subjects 1 through 7. For these subjects, increasing the shock intensity had only a slight suppressive effect and the social facilitation effect, if any, for a given subject was never as large as the largest effect obtained during the warning stimulus. For subjects 8, 9, and 10, however, the safe stimulus response rate with the co-actor absent was reduced by 40% of the pre-shock rate, at least, at one shock intensity. It can be seen that there was also a sizable social facilitation effect at these intensities. In fact, for these three subjects the largest social facilitation effect during the safe stimulus (110 v for S-8; 120 v for S-9; 390 v for S-10) was comparable to the largest social facilitation effect seen during the warning stimulus.

EXPERIMENT II

Subjects and Apparatus. Ten adult male White Carneaux pigeons were maintained at about 80% of free-feeding body weight; five served as subjects and five as co-actors. The five subjects had implanted electrodes for the delivery of shock (Azrin, 1959). The apparatus was the same as that used in Exp. I except that for Subjects 11, 12, 13, and 14 a metal plate covered the co-actor's response key.

Procedure. Subjects 11, 12, 13, and 14 were tested under a conditioned

suppression procedure in which a 2-min warning stimulus (green illumination of the response key) which ended with a 100-msec ac shock was presented at irregular intervals of time averaging 15 min. The warning stimulus was presented a total of three times in daily 1-hr sessions. Food reinforcements were scheduled according to a VI 1-min schedule. During the warning

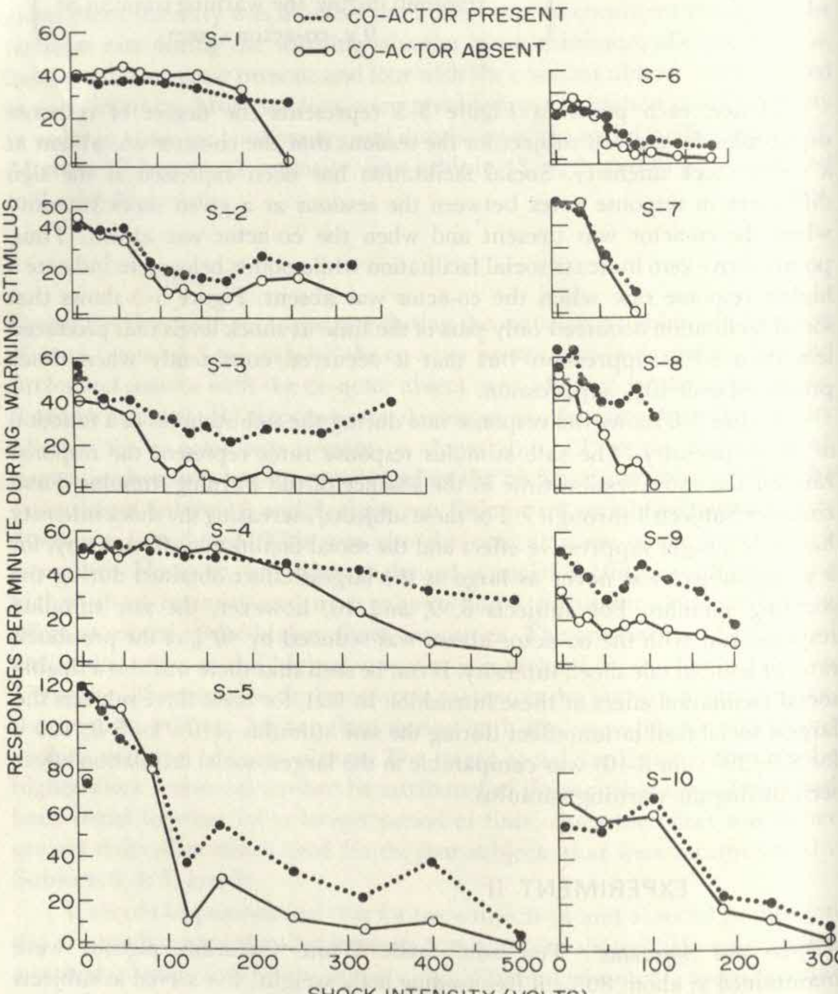

Figure 5-4. Social facilitation as a function of shock intensity. Responses per minute during the warning stimulus are given separately for sessions when the co-actor was present (solid circles) and for sessions when the co-actor was absent (open circles). Each point represents the mean of the last four sessions that the co-actor was present or absent at a given shock intensity. The unconnected points at 0 v for Subjects 3, 4, 5, and 8 are redeterminations obtained after the highest shock intensity.

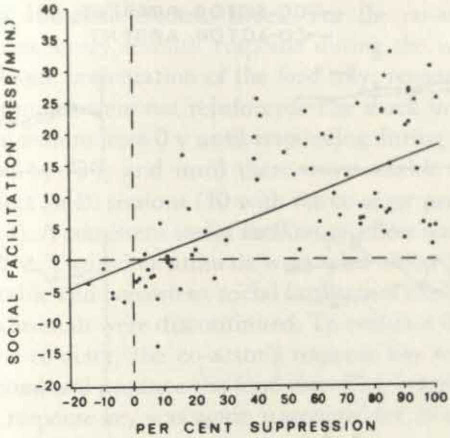

Figure 5–5. Social facilitation as a function of the amount of response suppression obtained at each shock intensity. Social facilitation is expressed as the sign difference in responses per minute when the average response rate for the sessions at a given shock intensity with the co-actor absent was subtracted from the response rate for the sessions with the co-actor present. Social facilitation has been plotted as a function of the per cent response suppression obtained at each shock intensity (see text for method of calculation). Positive percentages indicate suppression during the warning stimulus and negative percentages indicate that response rate during the warning stimulus was higher than it had been without shock. The line through the points is the line of best fit based on least squares.

stimulus, the co-actor's food tray was presented automatically for 3 sec with 1 sec between presentations. As a control for the effects of the co-actor's food tray *per se*, it was also presented in this manner during the alternate sessions when the co-actor was absent. The shock intensity was gradually increased over sessions from 0 v to a shock intensity at which response rates during the warning stimulus were reduced by at least 75% and until there was a sizable and consistent social facilitation effect for 20 sessions (10 with the co-actor present and 10 with the co-actor absent). A consistent social facilitation effect was obtained at shock intensities of 70 v for S-11, 180 v for S-12, 150 v for S-13, and 50 v for S-14. Then, in order to evaluate the effects of the mere presence of the co-actor, the automatic presentations of the co-actor's food tray were discontinued for a minimum of 16 sessions and then reinstated for 20 sessions.

Subject 15 was tested under a discriminated punishment procedure in which daily 30-min sessions included one 5-min punishment period after 10 min of the session had elapsed and another after 25 min. The warning stimulus for the punishment period was a change from white to green illumination of the response key. Responding was maintained on a VI 30-sec schedule of food reinforcement and, during the warning stimulus, every tenth response was

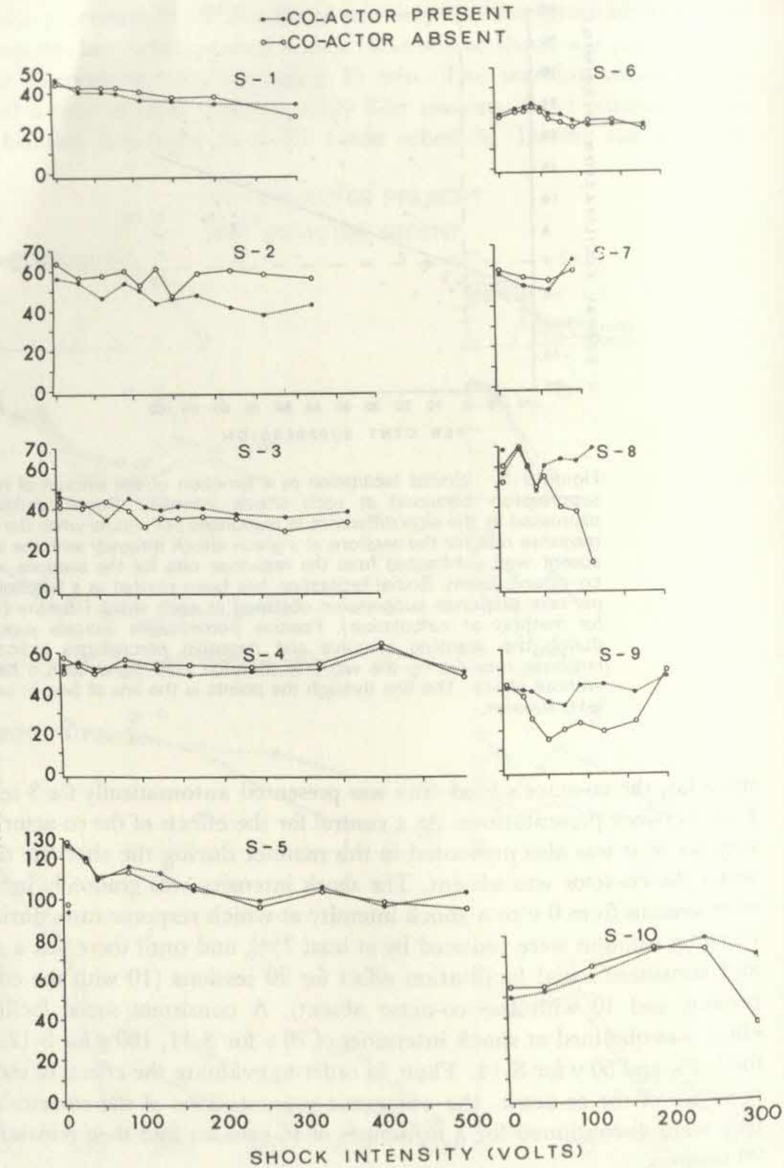

Figure 5-6. Response rate during the safe stimulus as a function of shock intensity. Responses per minute during the safe stimulus are given separately for sessions when the co-actor was present (solid circles) and for sessions when the co-actor was absent (open circles). Each point represents the mean of the last four sessions that the co-actor was present or absent at a given shock intensity. The unconnected points at 0 v for Subjects 3, 4, 5, and 8 are redeterminations obtained after the highest shock intensity.

followed by a 100-msec electric shock. For the co-actor, present during alternate sessions, every seventh response during the warning stimulus was followed by a 3-sec presentation of the food tray; responses in the absence of the warning stimulus were not reinforced. The shock intensity was increased gradually over sessions from 0 v until responding during the warning stimulus was suppressed by 75% and until there was a sizable and consistent social facilitation effect for 20 sessions (10 with the co-actor present and 10 with the co-actor absent). A consistent social facilitation effect was obtained at a shock intensity of 70 v. Two other animals were tried under the punishment procedure but sizable and consistent social facilitation effects were not obtained and these two animals were discontinued. To evaluate the effects of the mere presence of the co-actor, the co-actor's response key was covered so that it could not respond and produce the food tray. This lasted 54 sessions and then the co-actor's response key was again uncovered for 20 sessions.

Results

Figure 5–7 shows a session-by-session plot of the response rate during the warning stimulus at the shock intensity where a consistent social facilitation effect was obtained and the effects of the mere presence of the co-actor were evaluated. The first panel of Figure 5–7 shows the social facilitation effect obtained when the co-actor was eating (Subjects 11, 12, 13, and 14) or pecking and eating (S-15). This first panel also shows that the effect was not the result of the presentations of the co-actor's food tray alone, since for four of the subjects (11, 12, 13, 14) the co-actor's food tray was also presented during the sessions that the co-actor was absent. In the second panel of Figure 5–7, the effects of the mere presence of the co-actor were evaluated by eliminating all presentations of the co-actor's food tray. It can be seen that the social facilitation effect disappeared over sessions until the response rate during the warning stimulus was about the same regardless of whether the co-actor was present or absent. For two subjects (13 and 14), response rate initially increased. For these two subjects, the presentations of the food tray may have become part of the warning stimulus that signalled shock. After a few sessions without the presentations of the co-actor's food tray, however, the response rate during the stimulus decreased to about the level seen in the first panel for the sessions when the co-actor was absent. Reinstatement of the conditions under which the co-actor could eat during the warning stimulus (panel 3) was effective in reinstating a social facilitation effect for four of the five subjects. For these four subjects, the response rate with the co-actor present increased while the response rate with the co-actor absent remained about the same. It may be noteworthy that for the one subject for which social facilitation was not recovered, responding during the warning stimulus had dropped to a near-zero level.

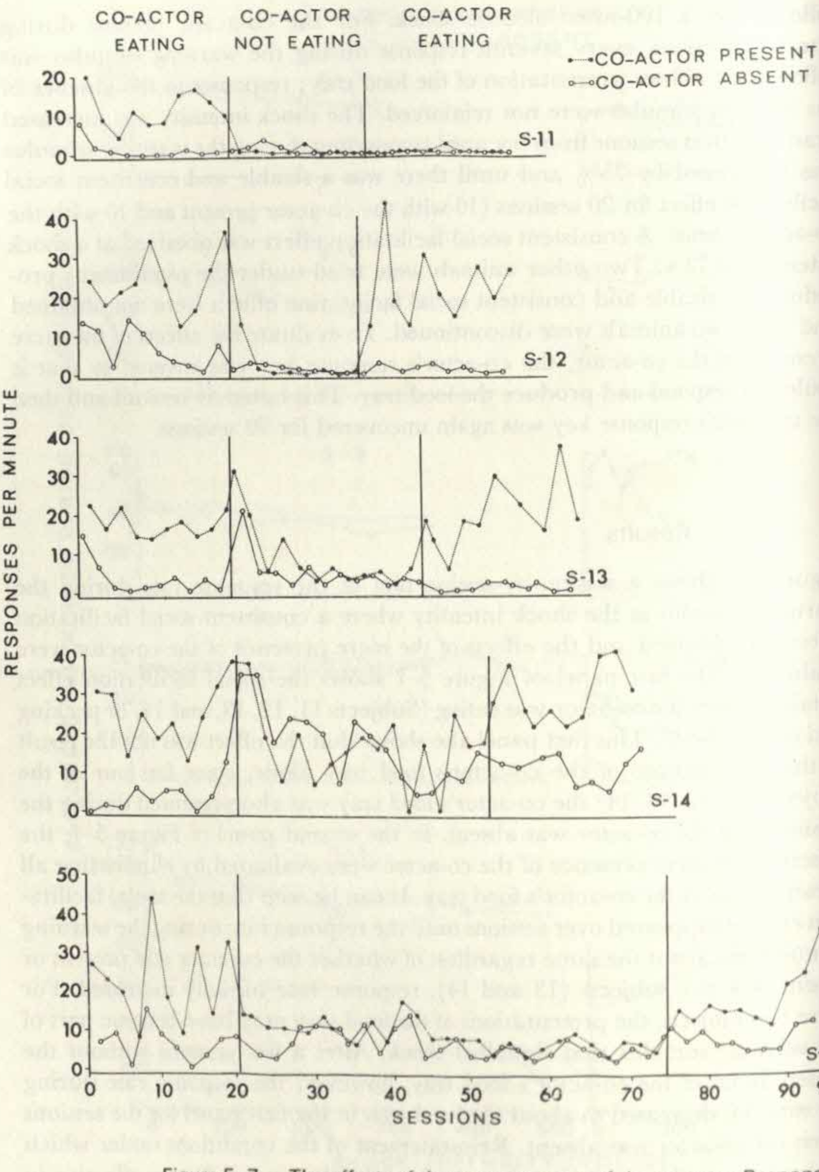

Figure 5–7. The effects of the mere presence of the co-actor. Responses per minute during the warning stimulus are given separately for sessions when the co-actor was present (solid circles) and for sessions when the co-actor was absent (open circles). The first and last panels show response rate during the warning stimulus when the co-actor was eating (Subjects 11, 12, 13, 14) or pecking the response key and eating (S-15). The middle panel shows the response rate during the warning stimulus when the co-actor was present but not eating. The shock intensity was 70 v for S-11, 180 v for S-12, 150 v for S-13, 50 v for S-14, and 70 v for S-15.

DISCUSSION

Previous research has indicated that the key-pecking response of pigeons maintained by a variable-interval schedule of food reinforcement, but suppressed during a stimulus paired with electric shock, may be socially facilitated by the presence of a co-actor emitting the same food-reinforced response (Hake and Laws, 1967). The present experiment extended these results by showing that the social facilitation effect obtained under these conditions was larger than that obtained when responding was not suppressed by electric shock and that the social facilitation effect increased as a function of shock intensity. It will be interesting to determine the extent to which these results extend to other species, to other procedures of aversive control, and to other schedules of reinforcement. There was some evidence in the present research that social stimuli may not have as large or as consistent an effect during a punishment procedure as they do during conditioned suppression. Only one of the three subjects tested under a punishment procedure in Exp. II showed a consistent and sizable social facilitation effect for 20 consecutive sessions. However, a definitive answer to this question, as well as the other questions concerning the generality of the present results, must await additional research.

It was pointed out in the introduction that at least two lines of evidence would predict a larger social facilitation effect when responding is suppressed by aversive stimulation than when it is not. One involved a special relationship between social stimuli and aversive stimuli in which the mere presence of another animal reduces emotional responses and thereby allows operant responses to increase. Several studies have shown that the presence of another animal can reduce emotional behaviors during aversive stimulation (Liddell, 1964; Harlow and Zimmerman, 1959; Hoffman *et al.*, 1966). In these experiments the subjects were young, had a special history with respect to their companion, *e.g.*, mother, imprinting stimulus, and, in two of the experiments, were allowed tactual contact with the companion (Liddell, 1964; Harlow and Zimmerman, 1959). The present results suggest that such variables may be critical to reducing emotional behaviors, since in the present experiment none of these conditions existed and the presence of another animal did not maintain the social facilitation effect. One other special relationship between social stimuli and aversive stimulation would predict a larger social facilitation effect during aversive stimulation than in its absence. The activity of a companion that has never been exposed to aversive stimulation could serve as a stimulus to the subject that the situation no longer contained aversive stimulation. In the present experiment, the sight of the co-actor responding could have served as a stimulus to the subject that shock was no longer forthcoming. Such vicarious learning does not appear likely in the present experiment, however, because shock continued to be delivered when the co-actor was present and the social facilitation effect endured for many sessions.

The second possible reason for a larger social facilitation effect when responding is suppressed by aversive stimulation than when it is not, concerned the sensitivity of a baseline suppressed by aversive stimulation relative to a baseline that is not suppressed by aversive stimulation. Previous studies of conditioned suppression and punishment indicate that changes in non-social variables such as food deprivation (Dinsmoor, 1952; Azrin, 1960; Azrin *et al.*, 1963) and frequency of reinforcement (Lyon, 1963; Church and Raymond, 1967) may produce proportionately larger changes in response rate when the responding is suppressed by electric shock than when it is not. The present results appear to provide another variable that produces a proportionately larger effect when responding is suppressed by aversive stimulation. All of the variables which have produced larger changes when responding has been suppressed by aversive stimulation affect the rate of responding for food reinforcement. The mechanism by which a co-actor increases response rate is not clear, but there are several possibilities. For example, the sight of the co-actor eating could: (1) elicit respondents which increase response rate, (2) produce a competitive situation, or (3) be a stimulus for a high frequency of reinforcement due to a history of group feedings. At any rate, the present results, taken in conjunction with previous findings, suggest an interaction between variables that affect the rate of food-reinforced responding and behavior which is maintained by food but suppressed by aversive stimulation such that a change in one of these variables produces a proportionately larger change in response rate when responding is suppressed by aversive stimulation than when it is not.

If this is the case, the question arises concerning what it is about responding under aversive stimulation that makes that responding more sensitive to social facilitation. Is it the aversive stimulation *per se*, the suppression, or the low response rate which in this case necessarily accompanied the suppression? Unfortunately the present research did not experimentally isolate which of these were critical. The relationship between social facilitation and response suppression, however, appeared particularly promising, since a consistent social facilitation effect usually did not emerge until responding was suppressed regardless of whether the shock intensity was 40 v or 200 v. This was also true during the safe stimulus: responding was suppressed whenever a sizable social facilitation effect was observed to spread to the safe stimulus. The present results also provide some data which argue against response rate as the critical variable. An explanation in terms of response rate alone would be that low rates of responding have more room to increase than high rates do. In the present study, the response rates before shock and at the lower shock intensities ranged from 20 to 120 responses per min with most subjects responding at rates of 40 to 60 responses/min. These response rates are far below the maximum capabilities of the pigeon and leave a wide range for response rate to increase. Yet Figure 5-4 revealed that only two of the 10 subjects showed a consistent social facilitation effect before shock was introduced and

at the lower shock intensities. Consider Subject 6, which responded at a low rate throughout the experiment. Before introduction of shock and at the lower shock intensities, the response rates of this subject were about 20 responses/min, a rate at which social facilitation always occurred with the other subjects when their responding was suppressed. Yet for this subject, a social facilitation effect was not observed until responding was suppressed. If low response rate alone had been the critical variable, it seems that social facilitation should have occurred more consistently before shock and at the lower shock intensities where rates were considerably below the maximum capabilities of the pigeon. The social facilitation effect occurred consistently only when responding was suppressed.

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Social disruption of performance on a DRL schedule

Ladd Wheeler
and
Hank Davis

A recent theory of social facilitation holds that organisms in a group are more aroused than when alone and that this greater arousal increases the probability that the dominant response in the hierarchy will be emitted (Zajonc, 1965). A stated implication of this position is that the presence of other organisms facilitates performance once learning has occurred, because the correct response is then dominant.

In many situations, however, the same response is reinforced at one point in time and not reinforced at another point in time. The presence of other organisms should disrupt performance in such a situation by enhancing the dominant response and thus causing it to occur at times when it will not be reinforced. The research described below demonstrates such social disruption of performance.

Subjects

Four male Long-Evans rats from the Naval Medical Research Institute colony were obtained at four months of age. Prior to training, the animals

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We thank Ira Donenfeld for his skillful assistance.

The experiments reported herein were conducted according to the principles enunciated in "Guide for Laboratory Animal Facilities and Care" prepared by the Committee on the Guide for Laboratory Animal Resources, National Academy of Sciences-National Research Council.

were maintained in a group cage with ad lib feeding. The animals were trained during their fifth and sixth months, during which time they were individually caged and maintained at approximately 80% of free-feeding weight.

Training

Training and testing were done in a Skinner box 12 in. × 12 in. × 9 in. (length × width × height). The feeder delivered 45 mg Noyes pellets. After receiving 100 reinforcements on a continuous reinforcement schedule, the animals were given approximately 40 training sessions of 80 reinforcements each over a two month period on a DRL 10 sec. reinforcement schedule (Differential Reinforcement of Low Rates). On a DRL 10 sec. schedule a response is reinforced only if it occurs 10 or more sec. after the preceding response. If a response occurs sooner than 10 sec. after the preceding response, the timer resets and another 10 sec. must elapse before a response will be reinforced.

Testing

Experimental sessions occurred on four consecutive days at the same time each day. On Days 1 and 2, each animal was given 40 min. alone on the DRL 10 sec. schedule. On Days 3 and 4, each animal was given 40 min. on the DRL 10 sec. schedule with another animal in the cage. The naive animal was of the same strain, sex, and approximate age and weight as the DRL animal. A print out counter pulsed once-per-sec. recorded inter-response times. The animals were monitored via closed circuit television.

Results

Table 5-3 presents summary data for each animal alone and paired. The number of inter-response times is shown to indicate the base of the medians

Table 5-3. Indices of DRL performance: alone and paired

	DRL-1	DRL-2	DRL-3	DRL-4
Number of inter-response times				
Alone	653	457	566	463
Paired	370	451	377	472
Median inter-response time				
Alone	6.7	9.0	8.4	10.5
Paired	5.6	7.0	7.8	10.2
Percent of responses reinforced				
Alone	31.6	50.7	42.5	65.6
Paired	23.2	32.3	34.2	62.2

Note—After applying square root transformations of (Alone-Paired) difference scores, t for median inter-response time = 5.08 ($p < .02$) and t for percent of responses reinforced = 5.96 ($p < .01$). Both tests are two-tailed with 3 df.

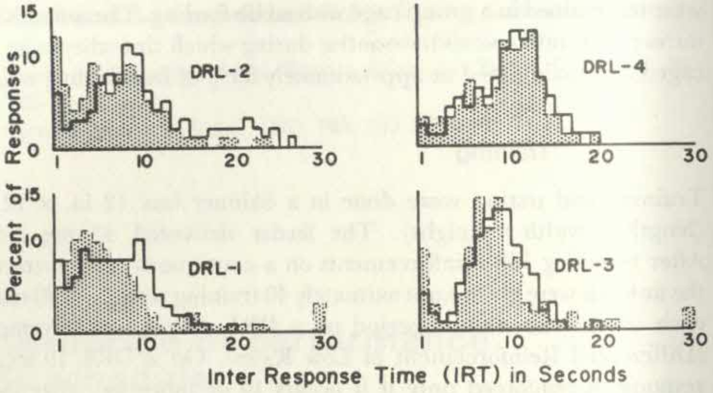

Figure 5-8. Distributions of Inter-response times. The heavily outlined white distribution is of IRTs when alone; the spotted distribution is of IRTs when paired with a naive animal.

and percentages. As is apparent from Table 5-3, all four animals had a shorter median inter-response time when in the paired situation than when alone ($t = 5.08$, $p < .02$). Further, every animal had a smaller percentage of his response reinforced when in the paired situation than when alone ($t = 5.96$, $p < .01$).

The distributions of inter-response times for each animal are presented in Figure 5-8. These distributions clearly indicate that the paired situation resulted in shorter IRTs than did the alone situation.

DRL-1. This animal was the poorest performer when alone. Yet placing him with another animal produced more inter-response times from 2 to 6 sec. and fewer from 9 to 14 sec. The greater frequency of inter-response times equal to or greater than 30 sec. in the paired situation was a result of periods of fighting and postural threat. Fighting on Day 3 led to the naive animal completely leaving the cage after 30 min., squeezing out under the hinged cage lid.

DRL-2. The frequency distribution of inter-response times when alone was characterized by a large number in the 20-sec. range and a peaking of responses at 9-10 sec. When paired with another animal, DRL-2 increased the frequency of 1 to 5 sec. inter-response times at the expense of inter-response times from 9 to about 25 sec. Due to fighting on Day 4, DRL-2 left the cage after 22 min.

DRL-3. When paired with another animal, this S most strikingly increased inter-response times of 1 sec. and, to a lesser degree, of 6-7 sec. There was also an increase in inter-response times of 17 sec. and greater, due to nonresponding

when the naive animal was near the lever and food cup. DRL-3 left the cage after 35 min. on Day 3 after sporadic fighting.

DRL-4. Pairing this animal produced only a slight change in inter-response times, increasing the 1-3 sec. and 6 sec. IRTs.

A discussion of territoriality under schedule conditions similar to these is available elsewhere (Davis & Wheeler, 1966).

Discussion

Animals on a DRL reinforcement schedule produced significantly shorter inter-response times in the presence of another animal than when alone and consequently received fewer reinforcements. Shorter inter-response times in the presence of another animal were predicted from Zajonc's theory (1965) that arousal is increased by the presence of other organisms and that the probability of emitting the dominant response is therefore enhanced. While the obtained results were predicted from Zajonc's theory, they are not consistent with his expectation that performance of a well-learned behavior is facilitated by the presence of other organisms. Under conditions such as the DRL schedule provides, when reinforcement of responses is dependent upon the passage of time, performance may be disrupted.

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6

AGGRESSION

Aggression is one social behavior occurring at too high a rate. The world is torn by the large-scale, organized aggression of war, the smaller-scale aggression associated with social unrest, the inter-personal aggression of violent crime, and the potential grand-scale aggression of nuclear, chemical, or biological holocaust. Although most individuals are not directly touched by serious, overt aggression, the high rate of aggressive behavior casts a shadow over everyone. One third of the people in America, and 40 percent of the people in America's cities are afraid to walk alone at night (Morris and Hawkins, 1969, p. ix). Man's potential for violence is exploited by politicians and employed as a weapon for social change. As a result, a climate of fear and repression has affected the lives of millions of individuals.

Aggressive behavior is behavior that inflicts aversive stimuli on another organism. It is one of the social behaviors most frequently attributed to the "nature of the beast." Anthropologists who study our carnivorous ancestors are quick to assume that we have inherited from them an aggressive drive. Konrad Lorenz, the famous naturalist, attributes aggression to an instinct that acts to select and preserve the species. In his view, the organism carries the potential for aggression inside him. The animal will eventually become "hungry" for aggression, just as it becomes hungry for food; the aggression will then burst forth whether or not the environment provides a stimulus (Lorenz, 1963). Our cultural history is replete with philosophers who have thrown up their hands in despair at the many instances of aggression that confronted them. Something seemed to drive man inevitably to harm others; whether that something was original sin or a biologically based drive, some mysterious force was used as an explanatory device.

However, as is the case with other social behaviors examined in this volume, there is an approach to aggression that specifies the environmental conditions that produce, maintain, and eliminate it. The experimental study of aggression began with the early work of O'Kelley and Steckel (1939), and Miller (1948), and has been followed by the more recent work of Ulrich and Azrin

(1962). In all of these studies, aggression was found to occur in response to electric shock. For example, Ulrich and Azrin (1962) found that, if two rats were placed in a chamber and were administered electric shock through a floor grid, they would immediately assume a stereotyped posture and strike out at one another. Aggression in response to pain was found to be a general phenomenon that occurred both intra- and inter-specifically in a variety of organisms ranging from rodents, birds, and reptiles to primates.

The aversive stimuli seemed to produce aggression in the same way a tap on the knee elicits a flexion response, or a light shone in the eye elicits pupillary contraction. The findings are important, not only because they advance understanding of aggression *per se*, but because aggression is an unusually complex behavior to be elicited by prior stimuli. Elicitation is generally effective only for simple behaviors with little involvement in the central nervous system and the skeletal musculature. These behaviors are known as respondents since they occur in response to prior stimuli. Indeed, the aggressive response to aversive stimuli has been conditioned in the same way as Pavlov conditioned a dog to salivate in response to a tone (Vernon and Ulrich, 1966). The reliability and generality of the effect suggests that a good deal of the aggression occurring outside the laboratory may be respondent behavior caused by aversive stimuli and conditioned aversive stimuli.

However, complex behaviors such as aggression are most often controlled by the reinforcers and discriminative stimuli known to control many social behaviors. The first paper included in this chapter investigates the possibility that aggressive behavior can be shaped and maintained as an operant behavior. The study is by T. J. Stachnik, R. Ulrich, and J. H. Mabry and entitled, "Reinforcement of intra- and inter-species aggression with intracranial stimulation." Studies involving reinforcement of human aggression had previously been made (Cowan and Walters, 1963; Staples and Walters, 1964). Other studies by Reynolds, Catania, and Skinner (1963) and by Ulrich, Johnston, Richardson, and Wolff (1963) successfully reinforced aggressive responses in pigeons with food and in rats with water. Unfortunately, the motor response necessary for eating and drinking compete with the aggressive response. This problem may be avoided through intracranial stimulation (ICS) of so-called "pleasure centers" in the brain. Intracranial stimulation involves passing a weak electric current through electrodes implanted in the brain. Depending upon the neuroanatomical placement of the electrodes and parameters of stimulation, for instance intensity and duration, ICS can increase or decrease the frequency of the response upon which it is made contingent. The animal does not stop being "hungry" for ICS as it stops being hungry for food. Stachnik, Ulrich, and Mabry were, in fact, successful in shaping and maintaining aggressive behavior using ICS as a reinforcer. However, the aggressive behavior differed topographically from

the aggressive response to aversive stimuli. Two unusual interspecific aggressive relationships were also maintained. Under ICS reinforcement, a rat would approach a cat—which it would not do without such reinforcement—and aggress against a monkey. This work, in combination with the other studies of reinforcement of aggression, shows that reinforcement can produce and maintain aggression in a variety of organisms.

Thus, two types of environmental stimuli were shown to cause aggression. Aggression could be elicited by aversive stimuli and also shaped and maintained by reinforcement. Together, these two environmental determinants could well account for the high incidence of aggression outside the laboratory. Aversive stimuli are all too abundant. In fact, they are most abundant in some of the environments, such as slums, where violence is also most abundant. In the army, in sports, and sometimes in the home, aggressive behavior is reinforced; competitive situations of many kinds can also reinforce aggression. Sometimes both causes may be used together: the drill instructor or football coach may deliver extra aversive stimuli to the men to elicit the aggressive behavior that he will then reinforce. The football player who goes onto the field as a professional doing his job may become more aggressive when hurt by another player.

The nature of the aggressive response to pain still requires clarification. Some light is shed on the nature of pain-induced aggression by the second paper included in this chapter, by N. H. Azrin, R. R. Hutchinson, and R. McLaughlin, entitled, "The opportunity for aggression as an operant reinforcer during aversive stimulation." In the experiment reported, a monkey received an electric shock; subsequently, he pulled a chain to obtain a ball that he attacked. In the absence of aversive stimuli no chain pulling occurred. The aversive shock seemed to create a motivational state in which the opportunity for aggression became a reinforcer and maintained an independent operant response. In a similar study, Azrin, Hutchinson, and Hake (1966) found that, when food delivery to a hungry pigeon was stopped, the pigeon would peck a key to obtain access to a second pigeon. The hungry pigeon would then attack the victim. This second experiment is reminiscent of the frustration-produced aggression studied by Dollard, *et al.* (1939).

The findings of Azrin, Hutchinson, and McLaughlin suggest that the aversive stimuli that appear to elicit aggression also create the motivational state that makes aggression, in effect, its own reinforcer. This aspect of aggressive behavior may help to account for the abundance of theories of aggression that rely on the internal state of the organism. The monkey and the pigeon both seemed to have an "urge to kill" causing them to make an extra response in order to be able to aggress. Perhaps a similar process occurs when animals and men appear to go out of their way to be aggressive. An observer may

notice signs of the motivational state and the reinforcing effect of the aggression. The observer may then conclude that something internal is driving the aggressor. However, in Azrin, Hutchinson, and McLaughlin's work, aversive stimuli were necessary for the initiation of the entire behavioral sequence. Some species-specific aggression seems to be similarly reinforcing. Siamese fighting fish will emit an operant response to obtain access to another fish. The second fish provides a visual display, which appears to elicit fighting (Thompson, 1963). A sequence such as this may be simply a case of social or sensory reinforcement, and, most certainly, is highly species-specific. There is no evidence that the phenomenon is general or, especially, that it occurs in man. Empirical observation once told our forefathers that "elements" such as earth, air, fire, and water were the makings of an earth located at the center of the universe. Refinements in observation and experimentation have destroyed these illusions. Perhaps the empirical observation that concludes that aggression is a spontaneous drive will be superseded by experiments such as that of Azrin, Hutchinson, and McLaughlin.

Azrin, Hutchinson, and McLaughlin's experiment also marks an improvement in the experimental technique for studying aggression. The study of aggression exemplifies the difficulties encountered when behavior is approached topographically. Aggression has been defined as the inflicting of aversive stimuli on one organism by another. However, one is tempted to include in the definition, perhaps, striking motions that do not connect, shots that do not hit target, and so forth. On the experimental level, even with a fairly restricted definition, human observers are usually necessary. Experimenters' bias, ambiguity in definition of the response, and other frailties can influence the experimental conditions and the interpretation of results. On the other hand, Azrin, *et al.*, used concise operationally defined responses (attacks on the ball) that are recorded automatically. Later the ball was refined into a pneumatic tube that monkeys would bite when shocked. Bites on the tube changed the internal air pressure, which could be automatically recorded (Hutchinson, Azrin, and Hake, 1966).

Regardless of the exact nature of the aggressive response to aversive and reinforcing stimuli, these stimuli clearly are causes of aggression. When causes of aggression are known, approaches to the prevention and suppression of aggression can be tried. In one attempt to reduce the rate of aggression, continuous shock was presented to two rats. When they ceased fighting, shock was discontinued. Under these circumstances, however, fighting actually increased (Ulrich and Craine, 1964). Other attempts to control aggression strengthened a specific competing response. Ulrich and Craine (1964) trained rats to press a bar to avoid presentation of shocks. When a second rat was put into the chamber with a responding rat, fighting initially replaced avoidance responding. Eventually, avoidance responding recovered some-

what, but never fully. In another study (Ulrich, 1967), two rats were taught to cooperate to escape shock by pressing bars within 15 seconds of each other. When separated by a plexiglas partition, the rats learned this cooperative behavior. When the partition was removed, however, the cooperation decreased somewhat and aggression moved in to take its place.

Successful control of human aggression in a nursery-school setting has been reported by Brown and Elliott (1965). Using a social reinforcement procedure as described in Chapter 3, Brown and Elliott successfully eliminated aggression by ignoring it as much as possible and by reinforcing competing behavior. The origin of the aggressive behavior was uncertain, but the control was, in fact, achieved.

Extinction of a specified response and reinforcement of competing behavior are two well-established methods for reducing the frequency of unwanted behavior. Punishment is another method that has, in some cases, seemed to be an effective suppressor of aggression. For example, Stachnik, Ulrich, and Mabry noticed that, when operant aggression was punished by the attacked organism, the aggressor's behavior was temporarily suppressed. On the other hand, Ulrich and Craine's (1964) results showed that punishment of aggression by continuous shock seemed actually to increase the aggression. The third paper presented in this chapter, by R. Ulrich, M. Wolfe, and S. Dulaney and entitled, "Punishment of shock-induced aggression," studies the effect of punishment on aggression. In this case, shock was used to induce monkeys to bite a rubber hose, and shock was also used to punish the bites. The punishing shocks followed the biting response immediately and were of a different intensity from the nonpunishing shocks used to produce aggression. Although differences between individual subjects were apparent, the punishment procedure was successful in suppressing biting in response to shock. Punishing shocks of less, as well as greater, intensity from the aggression-producing shocks suppressed the aggression. The effect of punishment on shock-induced aggression is far from clearly understood. Perhaps immediacy of punishment is crucial, and perhaps the punishing stimulus must be discriminable from the aggression-producing stimulus. Some of the complexities are apparent in Ulrich, Wolfe, and Dulaney's review of much of the literature on punishment and aggression.

Punishment is the method most widely used in our society for the suppression of aggression. Perhaps it is not the best method, but it will probably continue to be used. If punishment is to be used to control aggression, the conditions under which it will successfully suppress violent behavior must be discovered. Much of the punishment administered by society for aggression is aggressive or vindictive in nature. People convicted of violent crime are either killed or sent into a penal system where only lip service is given to rehabilitation.

Punishment that is in itself aggressive is blind and may create more aggression than it prevents.

Public concern has recently been aroused by the extreme violence, much of it reinforced, shown in films and on television. Because people do learn by imitation and observation, it is legitimate to ask whether these examples of aggression will be repeated in the real world. The best studies in this area (Bandura, Ross, and Ross, 1961, 1963a, 1963b; Walters and Llewellyn Thomas, 1963) do indicate that audio-visual displays of violence can increase the occurrence of aggression. However, the effect is small compared to the effect of the stimuli actually acting on the observing organism in everyday life situations. If a person's aggressive behavior is not elicited or reinforced, the person is unlikely to aggress simply because he watches a violent television show. Society's concern with the influence of audio-visual violence, although justified, should more profitably be with the effects of aversive stimuli and reinforcement on aggression.

Application of present and future results of experiments to the understanding of the causes and control of aggression could enormously reduce the violence in our society. The aversive nature and high frequency of aggressive behavior makes the acceptance of aggression as an unavoidable attribute of man a tragedy. Lorenz, for example, feels that, because aggression is biologically inevitable, to eliminate aggression by controlling causative environmental stimuli is impossible; he suggests that this inevitable aggression should be diverted into relatively harmless activities such as Olympic games. As a cure for the aggression in this world, Olympic games seem pitifully inadequate; such solutions, however, are the best that can be offered when one begins by accepting defeat. On the other hand, experimental research such as that presented in this chapter has shown that aggression is caused by aversive stimuli and by reinforcement of aggressive behavior. The convincing experimental demonstrations, plus the reasonable expectation that they are applicable to the nonexperimental world, make the assumption that aggression is inevitable and beyond control by environmental means unnecessary and unproductive. Instead of falling down before romantic allusions to nature as red in tooth and claw, we must subject the horrendous problem of our aggressive behavior to the experimental study that has already shown great success and promises more success in the future.

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Reinforcement of intra- and inter-species aggression with intracranial stimulation

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Roger Ulrich,
and
John H. Mabry

Ulrich and Azrin (1962) have shown that electric foot-shock can be used to elicit aggressive behavior in paired animals. This is a very reliable phenomenon which they have systematically related to a number of variables such as shock intensity, chamber size, sex, and developmental variables. It is also well established that electric intracranial stimulation (ICS) can be used to produce aggression and/or rage responses of a reflexive nature (Ranson, 1934; Wasman and Flynn, 1962; Masserman, 1964).

The present report concerns the use of intracranial stimulations (ICS) as a reward or a reinforcer for aggressive behavior. In this case electrode placements (in the posterior hypothalamus, one of the so-called "pleasure centers") are such that stimulation does not *elicit* any kind of aggressive response, but the animal will go to some lengths in order to procure stimulation.

The literature concerned with conditioned aggression is sparse, both in terms of operant and respondent conditioning. In an earlier paper Vernon and Ulrich (1966) referred to classically-conditioned aggression in rats. A tone was paired with shock a number of times until the tone alone produced an aggressive response. Thompson and Sturm (1965) also reported a classically-conditioned aggressive display in Siamese fighting fish (*Betta splendens*). One well known study in the literature of operantly conditioned aggression is that of Reynolds, Catania, and Skinner (1963) in which food-deprived pigeons

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attained food, contingent upon aggressive responses toward another pigeon. Ulrich, Johnston, Richardson, and Wolff (1963) did a similar kind of study with rats, in which they used water as a reinforcer for aggressive behavior. In both of these studies a stable pattern of aggression was developed and maintained. It is from this particular lineage that the present study can be traced; however, ICS is used as a reinforcer as opposed to more conventional stimuli such as food or water.

PROCEDURE

After injection of nembutal and chloral hydrate, electrodes were stereotaxically implanted in the posterior hypothalamus of gray-hooded and albino rats using the following DeGroot coordinates: anterior 4.4, lateral .5, depth 2.5 (DeGroot, 1959). Approximately two weeks after the operation the implanted rat was attached through swivel and wiring to a 100 pulse per sec, biphasic current source in a chamber about 15 in. square. A pulse of 0.5 sec duration was used throughout the study and was monitored with an oscilloscope. Five rats were used in the present study, selected from a population of implants, based on whether or not they could be trained to press a lever for ICS on a continuous reinforcement schedule (CRF). The intensity of the current used was adjusted to yield maximal bar pressing rates for each *S*. Due to the swivel arrangement the implanted animal could move about the chamber relatively freely. The 15 in. × 15 in. chamber was housed inside a larger chamber which had a one-way mirror in the door. An observer sat outside the large chamber looking through the one-way mirror and with a micro-switch was able to deliver ICS any time he chose. A naive, non-operated rat was placed in the chamber along with the implanted animal. The implanted rat was then given an extended sequence of "free" or non-correlated stimulations to note if the stimulation elicited any aggressive behavior toward the control animal.

If such stimulation elicited any kind of behavior whatsoever that particular animal was discarded. Thus, only animals for whom stimulation had no observable behavioral effect were used. Then we began, by the method of successive approximation, to shape aggressive behavior toward the control animal. Initially, simply looking at the control animal procured stimulation, then the implant had to move toward the control before he was reinforced, then he had to touch him. Then, by differentially reinforcing the vigorousness of touching, a stable pattern of aggressive behavior was developed and maintained. During shaping the animal was stimulated after each aggressive contact. Later, 2 sec of aggressive contact was used as the criterion for reinforcement and the recording of an aggressive response.

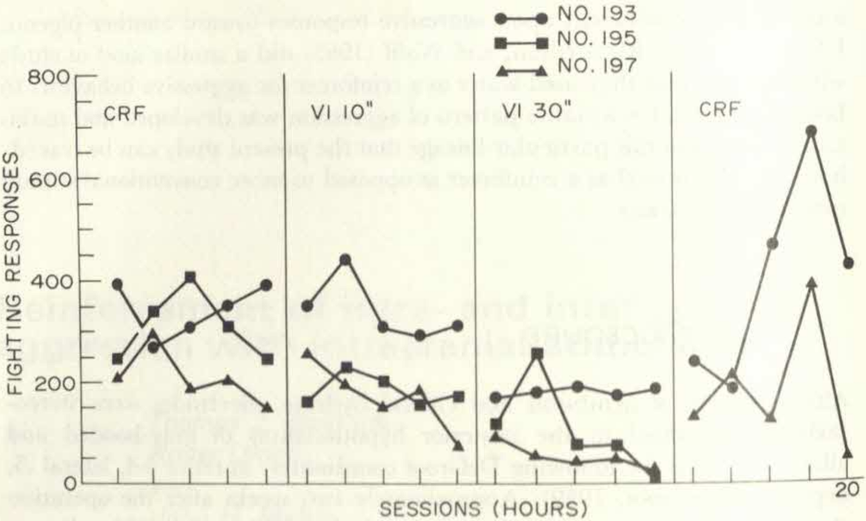

Figure 6–1. Number of fighting responses per session under CRF and intermittent reinforcement conditions for three implanted subjects. The electrode was pulled loose in #195 following VI 30" conditions and so the animal could not be run in sessions 16–20.

RESULTS AND DISCUSSION

The implanted animals struck and bit the control animals, shoved them about the chamber, and often knocked them down. During this period the behavior of the control animals varied considerably. Some of the time they were extremely passive, lying down and submitting to the attack. At other times, however, the control animal would strike back, which tended to bring both animals into the stereotyped fighting posture which has been consistently observed in studies of pain aggression (Ulrich and Craine, 1964; Ulrich, Hutchinson, and Azrin, 1965). The behavior of the control animal was probably the most important single consideration in explaining the variability noted in Figure 6-2. Although some characteristics of unconditioned aggression were present, the fighting appeared to be a function of operant reinforcement, since extinction occurred when the ICS contingency was removed. Moreover, the occasional pain-elicited and stereotyped aggressive behavior following counter-attacks by the control (noted previously) present a noticeable contrast to the arbitrary and flexible form or topography of the conditioned attack behavior.

Another question considered was whether or not the aggression could be maintained on an intermittent reinforcement schedule rather than one in which reinforcement followed each response (CRF). To answer this question three pairs of rats were run for five 1-hr sessions on the following schedules:

CRF, 10-sec variable interval, 30-sec variable interval, and then again on CRF. The results are presented in Figure 6-1. It can be noted that only two pairs of animals were run under the final CRF conditions because animal #195 had its electrode pulled out following the VI 30″ condition. It can also be noted that the level of aggression observed during CRF was not maintained by the intermittent schedules. This failure to maintain the same level of aggression can perhaps be explained in two ways. One possibility is that our electrode placements were such that the reinforcing effects were marginal, sufficient to maintain CRF aggression but too weak to maintain either ratio or interval performance. Similar results were found with water reinforcement (Carlton, 1961) where the bar pressing rate by moderately satiated rats was increased by reinstating CRF conditions following a fall-off in rate on various intermittent schedules. A second possible explanation involves the relative frequencies of reinforcement and the punishment administered in the form of counter-aggression by the control animal. Since reinforcement density is lowered when an intermittent schedule is introduced, while the frequency of punishment remains the same, it is not unreasonable that the frequency of attack would diminish.

One of the other things considered was the extent to which the reinforcing effects of intracranial stimulation could alter the typical relationship between a cat and a rat. Could an implanted rat, put into a chamber with a cat, be made to attack the cat? It was, of course, not expected that the same intensity of aggression noted during intra-species conditioning would occur in this situation. Obviously, a rat behaving very aggressively toward a cat would probably be a short-lived phenomenon at best. When a cat and a rat are placed together in a small chamber, in the absence of any reinforcement, the typical behavior of the rat is to avoid any kind of contact with the cat. The rat usually gets as far away from the cat as possible. The cat will, on the other hand, ignore the rat much of the time but at other times playfully bite the tail of the rat or paw it gently on the head. By making ICS contingent upon approaching the cat's head, the rat's behavior changed dramatically. Using this technique the implanted rat frequently initiated and maintained contact with the cat. While the contact was almost never of a vicious nature, there were times when the cat was obviously annoyed and would swiftly retaliate. The retaliation usually took the form of either striking the rat or placing on it one or both front paws thereby immobilizing it. Following this kind of behavior by the cat, it was difficult to get the rat to initiate any kind of contact. Sometimes in order to reinstate the behavior it was necessary to initiate a complete reshaping process.

When a squirrel monkey was substituted for the cat, there were some subtle but interesting differences in the form of aggression. The implanted rat appeared to be less intimidated by the monkey than it had been by the cat, as indicated by a more vigorous pursuit. When paired with the cat, the rat had readily made approach responses but seldom, if ever, had made striking or

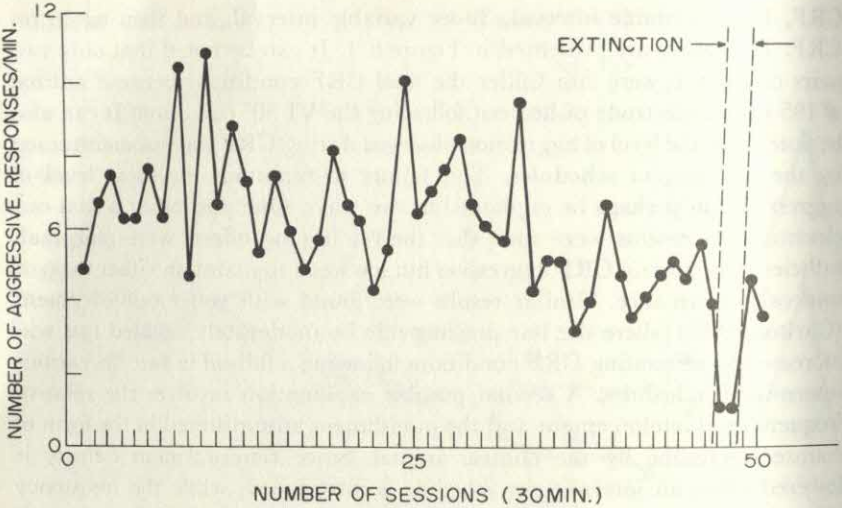

Figure 6-2. Number of aggressive responses made by implanted rat #201 when paired with a squirrel monkey.

biting responses. This was not true with the monkey. The implanted rat continuously initiated contact in the form of striking responses and occasionally would even bite the monkey. The frequency of aggressive contact by implant #201, over a period of fifty 30-min sessions, is summarized in Figure 6-2. The monkey's most frequent defensive measure during this time was to immobilize the implant. He usually did this either by firmly grasping the ears of the implant and holding it at arm's length or by pinning the rat to the floor of the chamber. After some struggle, the rat would free itself and come back up striking at the head of the monkey; the monkey would again attempt to restrain the rat. When this cycle had repeated itself a number of times the monkey would, on occasion, literally throw the rat against one of the walls of the chamber. When this kind of punishment had been administered, the same hesitancy in approaching the monkey that we had seen with the cat was noted.

Here again, the aggression was a function of operant reinforcement since the fighting responses during extinction sessions (sessions 47 and 48 in Fig. 6-2) were minimal and occurred almost solely at the beginning of each session.

There are several conclusions to be made. First, there are certainly some advantages in the use of ICS as a reinforcer in the study of aggression. Probably the most important advantage is that there is no disruption in the aggressive behavior of the experimental animal in order to obtain the reinforcer. In previous work, where conventional reinforcers like food or water have been used, the experimental animal had to leave the control animal in order to avail itself of the food or water. In the use of ICS this was not the case.

An attack in progress continued uninterrupted as stimulation was delivered. A second advantage was the fact that no apparent effects of satiation appeared. The ICS contingency exerted the same amount of control at the end of a 1-hr session, after many stimulations, as it did at the beginning of the session.

Although the aggression was primarily a function of operant reinforcement it was apparent that the situation was complicated by aggressive behavior from other sources. The sudden changes in the tempo and intensity of the aggression strongly suggested the presence of some unconditioned components. This has been recorded in an objective way by researchers who have used food or water reinforcement (Reynolds, *et al.*, 1963; Ulrich, *et al.*, 1963). They noted that experimental animals often became so involved in aggressive contact with the control animal that they failed to respond to the presentation of the food or water. Perhaps of greatest interest was the fact that no new set of behavioral principles was necessary to account for the behavior we observed. It appeared again simply a matter of the consequences of behavior determining whether or not the behavior was maintained.

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The opportunity for aggression as an operant reinforcer during aversive stimulation

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and
R. McLaughlin

Aggression between animals results from many factors such as territoriality, competition over food, defense against an intruder, and endocrine changes (Scott, 1958). Aggression also results from sudden foot-shock presented to paired rats (Ulrich and Azrin, 1962).

Two major problems have existed in the experimental analysis of this fighting phenomenon in rats: (1) the reliance upon a human observer to record the occurrence of an attack; and (2) the somewhat equivocal nature of the attack since physical injury was inflicted only occasionally. Arbitrary decisions were required as to which behaviors were aggressive and which were not. It was later found that obvious physical injury was produced when other species were used, such as paired monkeys (Azrin, Hutchinson, and Hake, 1963). The equivocal nature of the response was eliminated but the very viciousness of the attack behavior between monkeys made repeated measurement impossible. The still later finding (Azrin, Hutchinson, and Sallery, 1964) that monkeys would attack inanimate objects, simplified the problem of measuring the attack objectively and made it possible to obtain repeated measurement of the attack. A mechanical switch was attached to the cord by which the inanimate object was suspended in such a way as to produce a closure of the switch contacts when the monkey pulled the object to its mouth, thereby providing an objective record of the attack. The critical feature of this method was that an additional response was required: the ball had to be pulled as a prerequisite for attack to occur. A still better method would be to utilize a response requirement that was not a component part of the attack response, the nature of the response being dictated by methodological considerations rather than by the nature of the attack behavior. This objective of utilizing an arbitrary response to measure a motivational state is, of course,

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the same objective that has led to the use of bar-presses, chain-pulls, and panel-presses to measure the strength of motivational states as diverse as hunger and thirst (Skinner, 1938), imprinting (Peterson, 1960), escape (Dinsmoor and Hughes, 1956), avoidance (Sidman, 1953), and intracranial reinforcement (Olds and Milner, 1954). Among other advantages, the use of an arbitrary response also makes it possible to apply a common measure to various motivational states that otherwise are manifested by quite dissimilar behavior patterns. The present experiment attempts to ascertain whether an arbitrary response can be acquired by means of operant reinforcement when the opportunity to attack is utilized as the reinforcing event for that response.

METHOD

The general procedure in the present study was to use tail-shock to induce aggression in monkeys. An inanimate object was used as the object-of-attack.

Subjects

Five experimentally naive male squirrel monkeys served. Three other monkeys were discontinued: one because of an unusual adaptation to the shock which resulted in large intrasession changes in the probability of attack, and two because of the low probability of attack ($< .10$) against the inanimate object. This failure to elicit attack consistently from an occasional monkey has been noted previously (Azrin, Hutchinson, and Hake, 1963). Since the monkeys were not raised in captivity, many of their characteristics that are not completely known may have been contributing factors. For example, Hutchinson, Azrin, and Ulrich (in press) found that with rats, age, social isolation, and hormonal development were contributing factors for the existence of shock-elicited attack. The weights of the five subjects in the present study ranged from 570 to 870 g, with an average weight of 740 g. During the experiments, subjects were individually housed in cages in which food and water were continuously available.

Apparatus

The experimental chamber (see Fig. 6-3) measured 10 by 6 by 23 in. high and included a special chair (Hake and Azrin, 1963) which held the monkey in a loosely restrained position while allowing the delivery of pain-shock through tail-electrodes. The chamber was enclosed in a sound-attenuating enclosure that contained a one-way mirror. The tail-shock was delivered at an intensity of 400 v ac from the secondary of a transformer and through a 10 K ohm series resistor that stabilized the current flow. Each shock was 100 msec in duration.

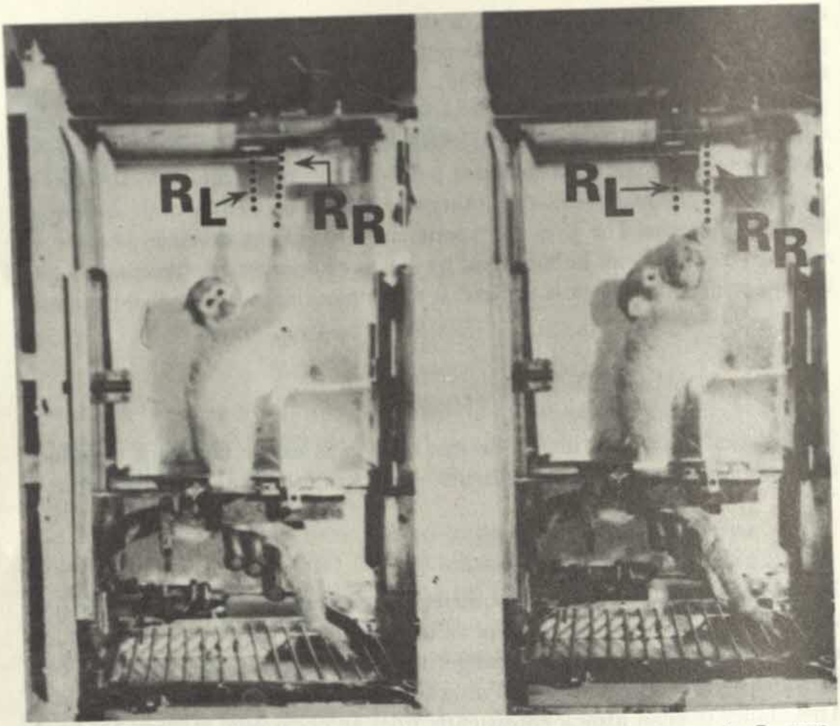

Figure 6-3. *Left photograph:* Squirrel monkey pulling on the R_R manipulandum. *Right photograph:* Attack on ball which has just been lowered as a result of a response on the R_R manipulandum.

The top of the inner chamber had an opening through which a canvas-covered ball, 2 in. in diameter, could be lowered by activating a motor. The ball could be similarly recovered through the opening by reversing the motor. "Reinforcement" as used here refers to the lowering of the ball through the opening to a distance of 4 in. from the ceiling where it remained for a duration of about 2 sec. At the end of the 2-sec period, the ball was automatically withdrawn through the opening. While the ball was in the lowered position, the monkey could grasp the ball and bring it to its mouth because of the flexible cord by which the ball was suspended. The cord (by which the ball was suspended) was attached to a microswitch, thereby providing closure of the switch contacts when the monkey pulled the ball to its mouth. This switch closure required a minimum of 80 g of force.

The manipulanda for the conditioned responses were two chains suspended through separate openings in the ceiling from two individual microswitches. The manipulandum on the right of the monkey is designated as R_R and that on the left as R_L. Both chains extended a distance of 4 in. from the ceiling, sufficient to enable the monkey to grasp the chain easily, yet not long

enough to be disturbed by the subject's casual movements. The two chains were 4.5 in. apart and were deliberately made physically different to increase the likelihood that subjects would discriminate between them. One of the manipulanda consisted of a simple bead chain; the other consisted of a bead chain enclosed in a narrow 0.25-in. diameter metal tube. Bead chain was used rather than the usual projecting bar or lever to reduce the subject's tendency to attack the manipulandum upon the delivery of the pain-shock. A pull exceeding 20 g was necessary to activate either switch; a response was defined as closure of the switch for a duration of about 0.5 sec. Maintained closure of this switch in excess of 0.5 sec counted as only one response. To be counted as a second response, the chain had to be released and pulled a second time. The 0.5-sec requirement was imposed to eliminate the possibility of counting as responses any momentary closures of the switch that resulted from random movements of the monkey. An important aspect of the apparatus, as mentioned earlier in Azrin *et al.* (1964), is that there be no projecting objects in the chamber that could be attacked easily other than the intended object-of-attack, which was the ball. All of the walls, as well as the waistlock which restrained the monkey, were constructed of micarta, the hard smooth surface of which effectively discouraged any biting attacks. The left section of Figure 6-3 is a photograph of a monkey responding to R_R. The right section of Figure 6-3 is a photograph of the subject attacking the lowered ball after having just produced the ball by pulling the chain.

Procedure

Table 6-1 outlines the experimental procedure. In Phase I, subjects were seated in the experimental chamber for 30 min. The tail was restrained in the electrode assembly, but no shock was delivered. The ball was in a lowered position for the entire 30-min session. The purpose of this phase was to ascertain the frequency of attack against the ball when no shock was delivered. Biting and grabbing of the ball by the monkey was recorded (1) automatically

Table 6-1

Phase	Shock condition	Reinforcement schedule (Availability of ball)	Manipulandum Availability
I	no shock	Continuously present	None
II	shock every 15 secs	Continuously present	None
III	shock every 15 secs	$R_R \rightarrow$reinforcement	R_R
IV	shock every 15 secs	$R_L \rightarrow$reinforcement	R_L
V	shock every 15 secs	$R_L \rightarrow$reinforcement	R_L, R_R
VI	shock every 15 secs	$R_R \rightarrow$reinforcement	R_L, R_R
VII	shock every 15 secs	$R_L \rightarrow$reinforcement	R_L, R_R
VIII*	shock every 15 secs	$R_R \rightarrow$reinforcement	R_L, R_R
IX	no shock	$R_R \rightarrow$reinforcement	R_L, R_R

*This Phase omitted for one subject.

by means of the microswitch that was connected to the ball and (2) manually by an observer through direct observation.

Phase II was identical to Phase I except that the brief tail-shocks were delivered every 15 sec for a total of 25 shocks. The purpose of Phase II was to ascertain whether attack would result against the ball upon the delivery of tail-shock when the ball was continuously present. This procedure was identical to that of a previous study (Azrin *et al.*, 1964).

During Phase III, only R_R was available. The brief shocks were delivered at regular intervals of 15 sec for a total of 120 shocks during the 30-min session. The ball could be lowered only by pulling the chain. Phase III attempted to ascertain whether the response of pulling R_R would be learned if that response were followed by the reinforcement of having the ball lowered for 2 sec.

In Phase IV, manipulandum R_L was available and R_R was absent. A closure of the R_L switch for 0.5 sec resulted in the immediate lowering of the ball for 2 sec similar to the procedures used in reinforcing R_R. Phase IV was designed to determine whether the monkey could also be conditioned to R_L. Phases III and IV provided reinforcement when only one manipulandum was present.

Phase V provided reinforcement for R_L when both R_R and R_L were available. This procedure is comparable to the common food reinforcement procedure in which two manipulanda are present, but responses on only one manipulandum result in the food reinforcement. Reinforcement on R_L was continued during successive sessions until the reinforced responses, R_L, constituted 80% or more of the total number of responses, $R_L + R_R$. In Phase VI, the reinforcement was discontinued for R_L and provided for R_R, thereby reversing the reinforcement contingencies. The number of sessions provided on Phase VI was determined by the same criterion used in Phase V. Upon reaching this criterion, the reinforcement contingency was then reversed in Phase VII, such that R_L was being reinforced and the responses on R_R were again nonreinforced just as they were in Phase V. During Phase VIII the reinforcement contingencies were again reversed.

The last Phase of the experiment, Phase IX, was identical to Phase VIII except that no shock was delivered.

The sessions were scheduled at the same time daily, Sundays excluded.

RESULTS

Little or no attack occurred toward the continuously present ball in Phase I when no shocks were delivered. Three subjects did bite or manipulate the ball during the first few minutes of the 30-min session, but by the end of 5 min, visual observations revealed no further contact.

When the shocks were delivered to the monkeys in Phase II while the

ball was in the lowered position, attack occurred consistently and immediately after each delivery of the pain-shock. Only the first few shocks failed to elicit attack against the ball since the initial reaction of the monkey to the shock was typically a scrambling escape-like behavior frequently accompanied by unsuccessful attempts to bite or attack the walls of the chamber. By the 10th shock, however, each subject vigorously bit the lowered ball immediately upon the delivery of every pain-shock. This consistent elicitation of attack against an inanimate object by pain-shock is in agreement with previous results utilizing the same procedure (Azrin *et al.*, 1964).

When the availability of the ball was made contingent on the chain-pull (Phases III and IV), the chain-pulling responses occurred consistently after each shock. Figure 6-4 shows the temporal distribution of the R_L responses during Phase IV when an R_L response resulted in the delivery of the reinforcement (ball lowered). It can be seen that the R_L responses were emitted primarily within the first 3.0 sec after the shock delivery. All subjects averaged at least one chain-pulling response for each of the 120 shocks. The results (not shown) for Phase III showed a similar temporal distribution of the R_R responses.

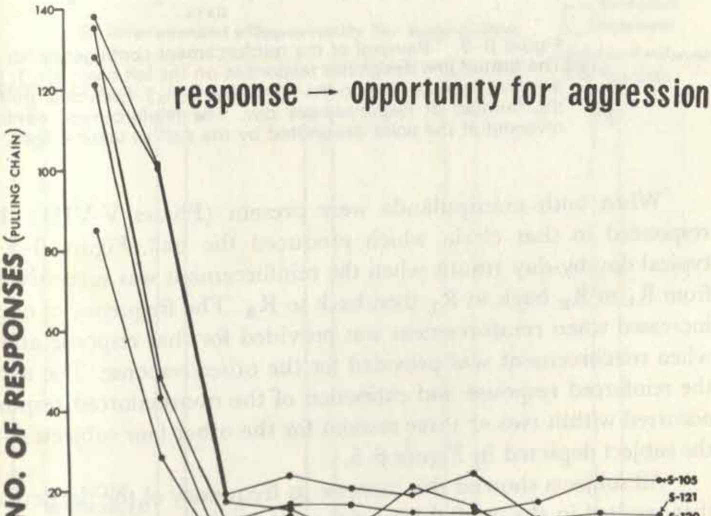

Figure 6-4. The number of chain-pulling responses as a function of time since the delivery of shock. The 15-sec period between shock deliveries was divided into 10 intervals of 1.5 sec. Each data point is the number of chain-pulling responses that occurred during each 1.5-sec class interval during one session.

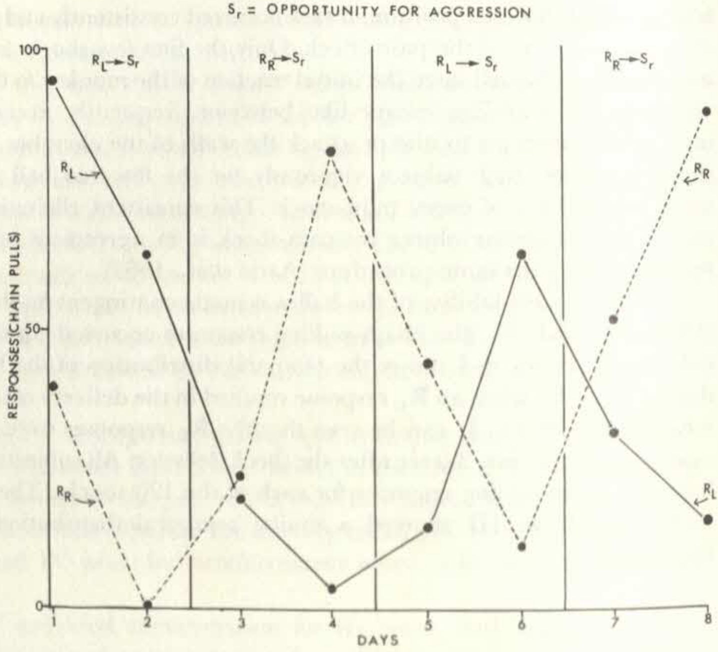

Figure 6-5. Reversal of the reinforcement contingency for one subject. The dotted line designates responses on the left chain (R_L); the solid line designates responses on the right chain (R_R). Each data point represents the number of responses per day. The reinforcement contingency was reversed at the point designated by the narrow vertical lines.

When both manipulanda were present (Phases V-VIII) the monkey responded to that chain which produced the ball. Figure 6-5 shows the typical day-by-day results when the reinforcement was successively changed from R_L to R_R back to R_L then back to R_R. The frequency of each response increased when reinforcement was provided for that response and decreased when reinforcement was provided for the other response. The acquisition of the reinforced response and extinction of the nonreinforced response usually occurred within two or three sessions for the other four subjects as well as for the subject depicted in Figure 6-5.

All subjects showed this increase in frequency of the particular response that resulted in the availability of the object-of-attack, and a decrease in the frequency of the response that did not result in the availability of the object of attack. This is shown in Figure 6-6, which compares the nonreinforced with the reinforced chain-pulling responses for each of the five subjects. The data is presented in terms of the percentage of chain-pulling responses and is based on the final day of reinforcement for Phases V, VI, VII, and VIII that preceded the reversal of the reinforcement contingencies. Each of the scores is based on four sessions (three sessions for one subject). It can be seen that for all

subjects, over 85% of the chain-pulling responses were emitted on the chain that resulted in the delivery of the object-of-attack. The absolute number of responses emitted is indicated for each of the subjects.

Figure 6-7 compares the number of R_L responses emitted in the presence of shock with the number emitted in the absence of shock. The white bar for each subject designates the number of R_L responses during the last session of Phase VIII, when the shocks were being presented every 15 sec. The solid bar designates the number of R_L responses during the single session of Phase IX when shock was not delivered. The R_L responses produced the ball under both conditions. It can be seen that the number of responses in the absence of shock was zero for subjects S98 and S105, and near-zero for the other three. Of the R_L responses that did occur in the absence of shock, all were emitted during the first 5 min of the 30-min session.

In the present procedure, reinforcement for a chain-pulling response was arranged by making an object-of-attack available for 2 sec. The question may be asked as to whether attack did indeed occur upon each presentation of the object of attack. An answer was attempted by taking two different measures of attack behavior. The first of these measures has already been described: a

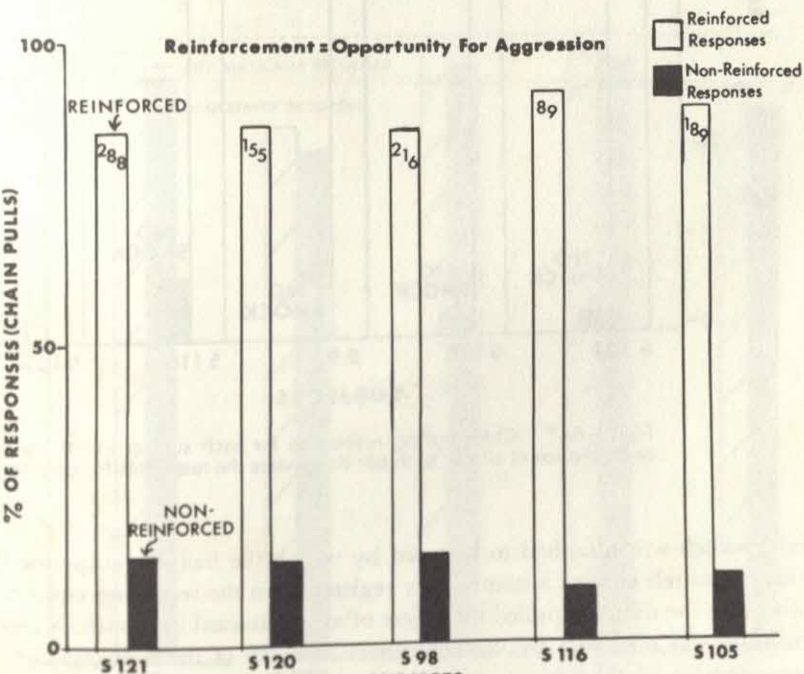

Figure 6-6. The average number and percentage of reinforced and nonreinforced chain-pulling responses for each subject. The R_L and R_R responses were combined. The absolute number of reinforced responses is presented at the top portion of the white bar.

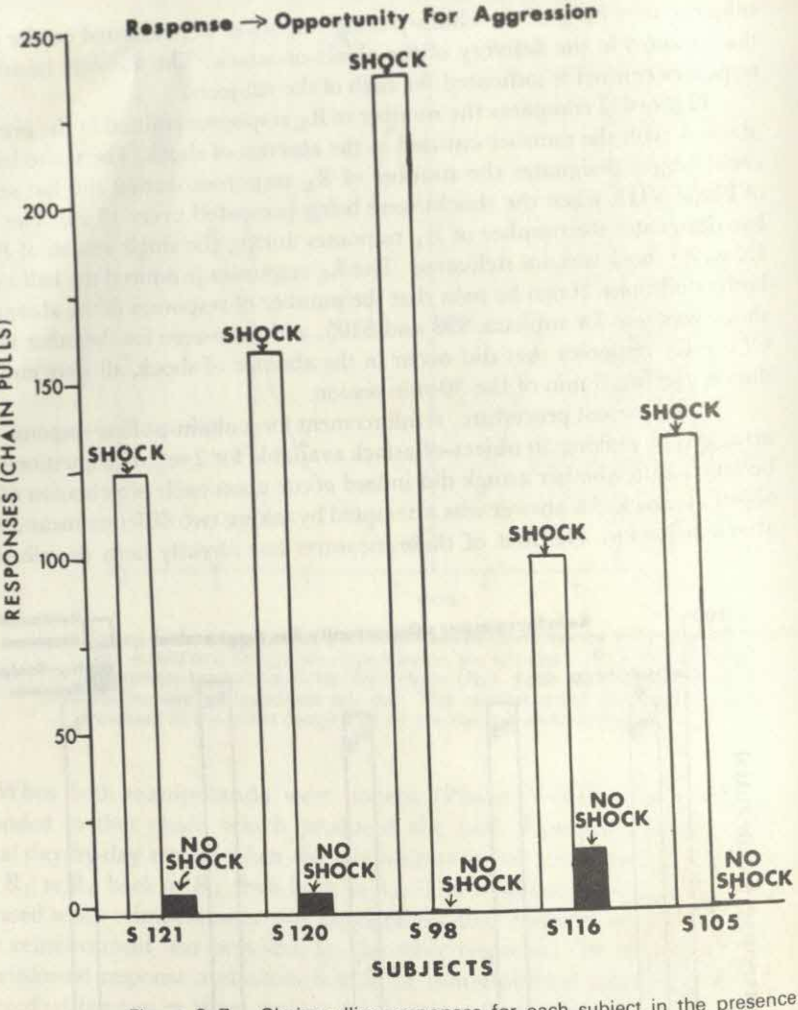

Figure 6–7. Chain-pulling responses for each subject in the presence and absence of shock. Each bar designates the responses for one day.

microswitch was attached to the cord by which the ball was suspended, so that the switch closure automatically registered on the recording equipment whenever the monkey pulled the object of attack toward its mouth. A second measure was obtained by visually observing each of the monkeys for 300 presentations of the object-of-attack during the course of the experiment. Each of these presentations resulted from a chain-pull. Figure 6–8 presents for each of the subjects the number of attacks as measured by these two different methods of recording. The horizontal dotted line shows the total

number of presentations (300) of the object of attack. The stippled bar shows the number of attacks as measured by the closure of the microswitch to which the object-of-attack was attached. No more than one attack was considered to have occurred during a given presentation of the object-of-attack even though the switch may have repeatedly closed and opened during that presentation. Thus, the number of attacks as measured by the closure of the switch could not exceed the number of presentations of the object-of-attack. It can be seen that the number of attacks as measured by the closure of the switch corresponds very closely to the number of presentations of the object-of-attack. For three of these subjects, the correspondence was almost perfect: a closure of the switch resulted on 97% or more of the presentations of the object-of-attack. The correspondence for the other two was fairly close: 85% and 91%. The correspondence between the observer-noted attack (solid bar) and the automatic switch-recorded attack (stippled bar) is again very close, differing by no more than 5% for any subject. The observer-recorded attacks also correspond closely with the number of opportunities for attack: the greatest discrepancy is for S120, about 15%, but less than 10% for the other four subjects.

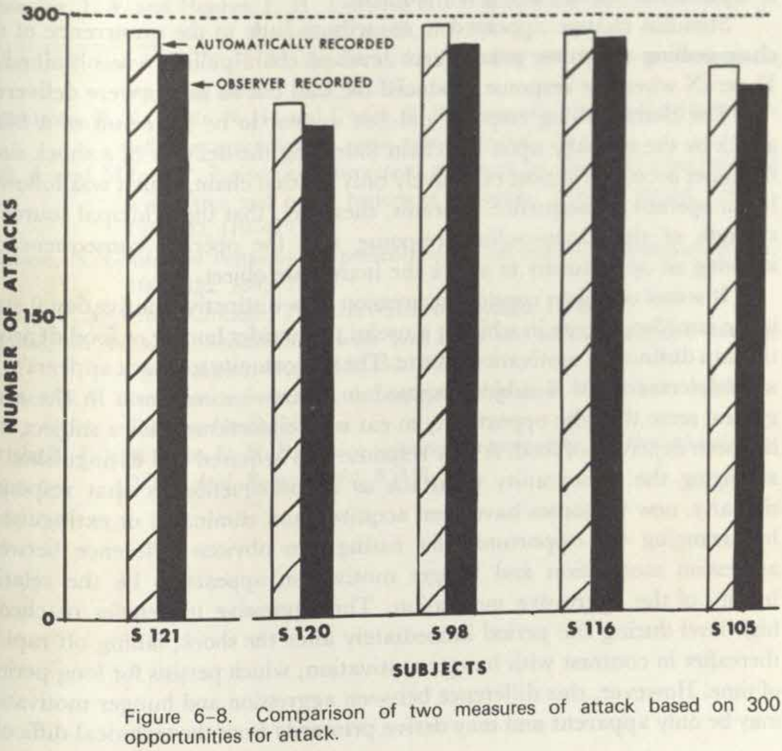

Figure 6–8. Comparison of two measures of attack based on 300 opportunities for attack.

DISCUSSION

The present findings confirmed the results of previous studies (Azrin *et al.*, 1964) in demonstrating the existence of attack against inanimate objects as a result of aversive stimulation. Little or no attack was seen in the present study when the object-of-attack was continuously available but no shock was presented. On the other hand, attack was consistently elicited toward the continuously available object-of-attack when shocks were presented. Similarly, the chain-pulling responses dropped to a zero level in the absence of shock, but increased to a high level when the shocks were being delivered. Thus, it appears that the delivery of shock was necessary to produce aggression as measured either by the actual biting of the object-of-attack or by the frequency of the chain-pulling responses that produced the object-of-attack. The successful conditioning of the chain-pulling response offers a way to quantify the strength of aggression-motivation without the need to adapt the recording apparatus to the perhaps unique mode of attack (biting, grabbing, slapping, "threatening") that happens to be utilized by a particular animal or a particular species at a given moment.

Stimulus change appeared to contribute little to the occurrence of the chain-pulling response: a near zero level of chain-pulling was obtained in Phase IX when the response produced the ball but no shocks were delivered.

The chain-pulling response did not appear to be the result of a blind attack by the monkey upon the chain following the delivery of a shock since responses occurred almost exclusively only on that chain, which was followed by an operant consequence. It seems, therefore, that the principal source of strength of the chain-pulling response was the operant consequence of allowing an opportunity to attack the inanimate object.

It seems useful to consider aggression as a distinctive motivational state in the same loose sense in which it is useful to consider hunger or food deprivation as a distinctive motivational state. The opportunity to attack appears to be a reinforcement for a subject exposed to aversive stimulation in the same general sense that the opportunity to eat is a reinforcement for a subject that has been deprived of food. A new response was acquired and extinguished by arranging the opportunity to attack as a consequence for that response; similarly, new responses have been acquired and eliminated or extinguished by arranging the opportunity for eating. An obvious difference between aggression motivation and hunger motivation appears to be the relative brevity of the aggressive motivation. The aggressive tendencies reached a high level during the period immediately after the shock, falling off rapidly thereafter in contrast with hunger motivation, which persists for long periods of time. However, this difference between aggression and hunger motivation may be only apparent and may derive primarily from the technical difficulty

of maintaining a continuing state of aversive stimulation in a manner fairly comparable to the maintenance of a continuing state of food deprivation. Some support for this suggestion was obtained in previous studies. When continuous foot-shock was provided for short durations (Azrin, Ulrich, Hutchinson, and Norman, 1964) attack was observed for a major part of the duration of the shock delivery, being interrupted primarily by the competing motor reactions elicited by the shock. It appears that shock creates a motivational state in which the opportunity to attack is a reinforcing event for the duration of stimulation and for a brief period after the cessation of stimulation.

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Punishment of shock-induced aggression

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Marshall Wolfe,
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Sylvia Dulaney

Rats, cats, hamsters, monkeys, and other animals have been observed to attack a partner after presentation of electric foot-shock (Ulrich, Hutchinson, and Azrin, 1965). Furthermore, such fighting in response to aversive events is not confined to members of like species, but occurs between animals of unlike species as well (Ulrich, Wolff, and Azrin, 1964). Other aversive events that produce a fighting reaction are intensely heated floors, back shock through implanted electrodes (Ulrich and Azrin, 1962), tail shock (Azrin, Hutchinson, and Sallery, 1964), tail pinch (Azrin, Hake, and Hutchinson, 1965), morphine withdrawal (Boshka, Weisman, and Thor, 1966) and food removal (Azrin, Hutchinson, and Hake, 1966; Thompson and Bloom, 1966). The pain-aggression reaction thus appears to be a general phenomenon occurring among a wide variety of animals in response to many different aversive events.

Nonaggressive responses have been conditioned as a function of escape from or reduction of the same aversive events that produce aggression (Sidman, 1966). The fact that aversive stimulation produces aggression as well as escape and avoidance led to several investigations of their interaction in situations where both behaviors were possible (Ulrich and Craine, 1964; Ulrich, Stachnik, Brierton, and Mabry, 1965; Ulrich, 1967*a*; Azrin, Hutchinson, and Hake, 1967; Taylor, Ulrich, and Colasacco, 1969). These studies showed that the interaction between unconditioned fighting and escape-avoidance varied as a function of the history of the subjects, their physical proximity, and the nature of the escape-avoidance response.

Another important aspect of aversive stimulation is its punishing effect

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(Azrin and Holz, 1966). When an aversive event closely follows a response, the subsequent frequency of that response decreases. This punishment phenomenon poses an interesting question regarding the consequent control of aggression. Since aversive stimulation produces aggression, it has been suggested that the use of punishment to suppress aggression may be an inappropriate technique (Ulrich, 1967*b*). The delivery of shock immediately after an aggressive response may, in fact, produce an even greater frequency of aggression than if it were not delivered. On the other hand, it may be found that the aggressive response would be suppressed by response-contingent aversive events.

The purpose of this study was to examine the effects of following each shock-induced aggressive response with additional shock.

METHOD

Subjects

Three mature male squirrel monkeys, weighing between 650 and 800 g, were housed individually with continuous access to food and water, which was supplemented with additional vitamins. All subjects were experimentally naive before the start of the study.

Apparatus

The restraining chair and bite-hose apparatus are described in detail by Hutchinson, Azrin and Hake (1966). Briefly described, it consisted of a Plexiglas chair that securely restrained the subject at the waist and still permitted relatively free movement of the upper portion of the body. The tail was restrained under shock electrodes. A rubber bite hose was mounted on the wall in front of the monkey's face. Biting the hose produced a change in air pressure that, by means of a pressure transducer, caused the contacts of a silent switch to close and thus record a discrete bite. The Plexiglas restraining chair was housed in a larger outer chamber that provided light and sound attenuation, ventilation, and masking noise. The chamber also contained a 60-db, 10,000-Hz tone generator. The presentation and duration of this tone were controlled by the scheduling equipment. The monkeys could be monitored by means of a closed-circuit television located in an adjacent room, along with the scheduling and recording equipment.

Procedure

Before shock presentation, each subject was placed in the experimental situation in order to provide a no-shock baseline of biting. In this phase, as in all other phases of the experiment, the sessions were 1-hr long. When biting

during the no-shock baseline reached a near-zero level, scheduled non-response-contingent shock sessions were begun.

Shock was delivered through a 50,000-ohm resistor in series with the monkey's tail. The tail was shaved, and impedance reduced to approximately 15,000 ohms with electrode paste, In each session, 10 shocks were delivered, one every 5 min. Each scheduled shock was 300 v ac and was 0.1 sec in duration.

After several shock sessions, a punishment procedure was introduced. During this phase, the ten, 300-v scheduled shocks continued to be delivered; however, each bite was immediately followed by an additional shock. For all subjects, the second shock was 600 v ac for 0.1 sec. When the number of bites during these sessions stabilized, the punishment contingency was removed.

For Subject 1, two additional bite-contingent stimuli were examined. Instead of the previous 600-v shock, a less-intense shock of 150 v was used. After a second return to the scheduled shock-alone conditions, a tone of 0.1-sec duration was presented as a consequence of each bite. This phase was then followed by a final return to scheduled shock-alone conditions.

RESULTS

Figure 6-9 shows hose biting during all phases for all subjects. The left side of the figure shows the total number of bites per session for each subject. Directly to the right are cumulative records for the same subject that illustrate the rate of biting within representative sessions.

During the first session of the no-shock phase, Subject 1 (top graph, left side) bit the hose 103 times. The cumulative record of that session (top, right side of Fig. 6-9) shows some biting at the beginning and near the end of the session, with periods of time exceeding 15 min in which no biting occurred. This initial rate of biting was not typical of the no-shock phase, since with the exception of one other session, no more biting occurred.

The initial presentation of scheduled shocks (Session 17) produced a sudden increase in biting to 316 for the first session of the phase. Throughout this phase (Sessions 17 to 33), biting varied between a low of 105 and a high of 497. The cumulative record of Session 17 and another record (Session 33), which is more typical of this phase, are shown in the cumulative graphs for Subject 1. In Sessions 17 and 33, it can be seen that although biting always occurred directly after shock presentation, it occasionally continued well into the inter-shock interval.

The punishment phase for Subject 1 was initiated in Session 34. During this phase, each bite produced a 0.1-sec 600-v shock. The subject bit 127 times during this session. The cumulative record shows that the major portion of the biting occurred before the first scheduled shock was presented. It should again be emphasized that these bites also produced a punishing shock.

Throughout the remainder of the punishment phase, biting ranged from zero to eight bites per session. During these sessions, all biting closely followed the delivery of one of the scheduled shocks. A typical cumulative record taken from another session of this phase (Session 44) appears as a straight line.

In Session 47, the punishment contingency was removed and the subject bit 43 times. In subsequent sessions, biting returned to levels equivalent to those observed in the initial scheduled-shock phase. The cumulative record of Session 47 shows an increase in biting within the session, with no bites occurring before presentation of the seventh shock. Cumulative records typical of the post-punishment sessions were similar to the records taken from previous sessions under the same conditions. A cumulative record of Session 58 illustrates this similarity.

The second punishment phase, using a less-intense punishing shock, immediately suppressed biting. The total number of bites during the first session of this phase (Session 63) was eight. Bites throughout the entire phase never exceeded 17 per session. Cumulative records taken from sessions in this phase were similar to the first punishment phase.

Hose biting recovered immediately after the punishment contingency was removed (Sessions 77 to 100). The data collected during Sessions 83 to 88 were invalidated due to an apparatus malfunction.

The presentation of a tone contingent upon each bite was found to be ineffective in suppressing hose biting. In fact, biting during this phase ranged from a low of 204 to a high of 666, the highest ever recorded for Subject 1. The removal of contingent tone showed no apparent change in hose biting from that observed in other nonpunishment sessions.

All experimental phases for Subject 2 are shown in the middle portion, left side of Figure 6-9. Representative records for this subject are shown on the right.

Bites during the no-shock phase ranged from 0 to 265 per session. Cumulative records of Sessions 1, 6, and 22 illustrate differences both in the total number of bites between sessions, and differences in the rate of biting within sessions. The even slope of Session 6 reflects a stable rate of biting throughout the session, while Sessions 1 and 22 show sudden bursts of biting at different times within the session. With the exception of one session, biting in the second half of the no-shock phase occurred at a lower and more stable rate.

Bites during the initial shock phase also varied greatly, ranging from 106 to 815. Two hundred and seventy-nine bites were recorded during the initial session (Session 40) of this phase. The cumulative record of this session shows that all biting occurred after the sixth shock. Cumulative records taken from later sessions of this same shock phase (Sessions 41 and 45) were more typical. Although the number of bites during Sessions 41 and 45 differed greatly, the occurrence of biting in both cases was not obviously related to shock delivery. In this respect, Subject 2 differed from both Subjects 1 and

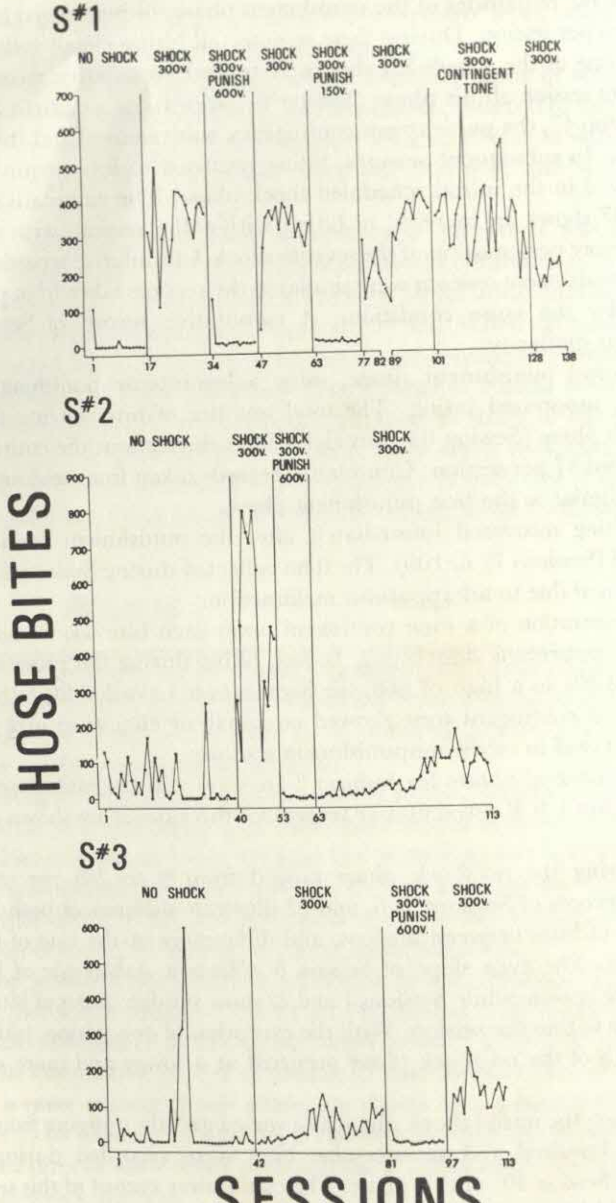
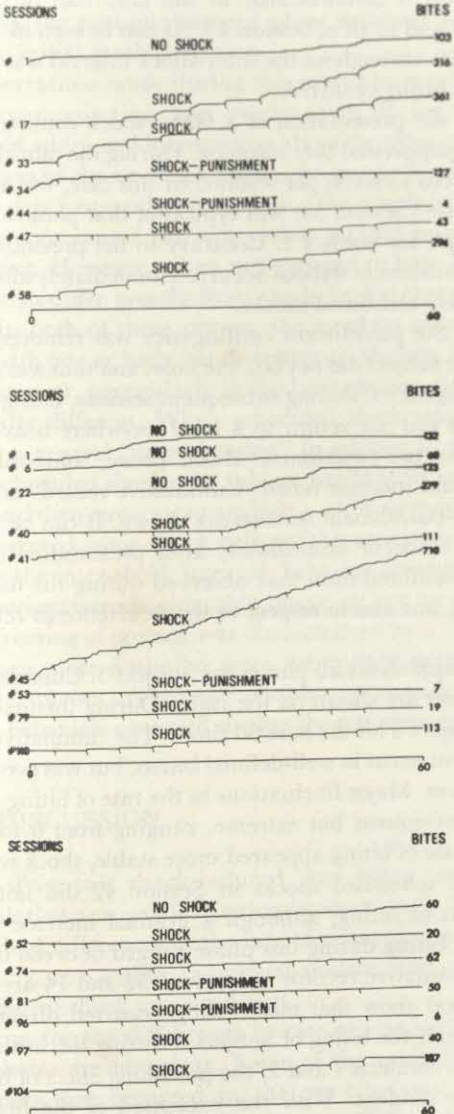


Figure 6-9. The rate of hose biting between and within sessions for all subjects. The left side of the figure shows the total number of hose bites recorded during each session. The experimental conditions are labeled at the top of each of the individual graphs and the first session of every phase is numbered. The corresponding cumulative records on the right show the rate of hose biting within selected sessions for the same subject. The number of



each session from which the cumulative record was taken is listed at the beginning of each record, and the total number of hose bites per session is given at the end. The experimental phase is identified above each cumulative record. Diagonal marks indicate delivery of a scheduled shock.

3. This tendency to bite throughout the inter-shock interval with little regard to shock presentation is demonstrated in the later half of the cumulative record of Session 40 and in all of Session 45. As can be seen in Session 41, this same tendency to bite throughout the inter-shock interval was also present in sessions where little biting occurred.

In Session 53, the presentation of a 600-v shock contingent upon hose biting immediately suppressed that response. During the punishment sessions, bites ranged from zero to seven per session. In this case, the initial session of the punishment phase (Session 53) was typical of that phase and is shown in the cumulative graph for Subject 2. Contrary to the previous condition, all biting during the punishment sessions occurred immediately after presentation of one of the regularly scheduled shocks.

In Session 63, the punishment contingency was removed. During that session, however, the subject did not bite the hose, and thus was not affected by the change in contingencies. During subsequent sessions, biting did occur, but the number of bites did not return to a level anywhere near that observed during the previous pre-punishment shock phase, and only after many sessions was a gradual increase noted. Cumulative records taken from both early and later post-punishment sessions are shown. It can be seen that most hose biting tended to occur immediately after presentation of a scheduled shock. Thus, biting differed from that observed during the first shock phase not only in amount, but also in respect to its occurrence in relation to shock presentation.

The bottom graph shows all phases for Subject 3. Cumulative records of representative sessions are shown on the right. During the first session of the no-shock phase, Subject 3 bit the hose 60 times. The cumulative record shows that this biting did not occur in well-defined bursts, but was evenly distributed throughout the session. Major fluctuations in the rate of biting during the no-shock phase were infrequent but extreme, ranging from 0 to 602 bites per session. When this rate of biting appeared more stable, shock was introduced.

Presentation of scheduled shocks in Session 42 did not dramatically increase the amount of biting, although a gradual increase occurred over subsequent sessions. Biting during this phase ranged between 0 and 135 bites per session. The cumulative records of Sessions 52 and 74 are typical of the first shock phase, and show that most biting occurred directly after shock presentation. Although the biting of Subject 3 during the initial shock phase was never as great as Subjects 1 and 2, the punishing effect of bite-contingent shock was still very evident. With the exception of the first punishment session (Session 81), in which 50 bites were recorded, biting during the punishment phase ranged between 0 and 11 bites. During Session 81, most biting occurred before presentation of the first scheduled shock. Session 81, and a cumulative record more typical of the punishment sessions are shown.

As with Subject 1, biting during the first session after the punishment contingency was removed increased as the session progressed. In this session

(Session 97) no biting occurred before the seventh shock. Again, all biting tended to follow the presentation of one of the scheduled shocks. For Subject 3, biting during the post-punishment phase returned to a level somewhat higher than the initial shock condition.

Other observations made during this study also merit reporting. Closed-circuit television monitoring, and movies taken during each of the various phases, provided additional information about the subjects' behavior. During the major portion of the no-shock phase, the monkeys generally appeared at ease, although they frequently bit the hose. The scheduled shocks during pre-punishment sessions caused obvious violent skeletal muscle activity and an increase in biting. However, when not engaged in hose biting, the behavior did not appear to differ greatly from the behavior observed during the no-shock phase. In both of these phases, the monkeys generally sat in an upright posture with one or both hands resting on the bite hose. In the punishment phase, however, particularly in the later sessions, the subjects' behavior was dramatically different. When scheduled shock was delivered, all subjects exhibited a general "apprehension" in relation to the bite hose. Upon delivery of a scheduled shock, the subject would jerk, move rapidly toward the bite hose, and then move away again in a whirling motion. Although much activity was observed, upon shock delivery this activity seldom included hose biting. During the inter-shock interval, behavior was typified by either self-abuse (finger biting, face clawing, side biting, *etc.*) or by a general freezing of posture. This freezing of posture was characterized by a crouched or slumped position that was quite dissimilar from the upright posture observed in the non-punishment phases. When the punishment contingency was removed, the additional behaviors observed during the punishment phase ceased.

DISCUSSION

These results show that shock-induced hose biting was suppressed when aversive stimulation was made contingent upon each biting response. Although individual differences in the rate of responding occurred among subjects and among and within individual sessions, the suppressing effect of response-contingent shock was consistent.

The reasons for the differences in rate of responding during the non-punishment phases are not clear. Some of the variability may have been related to events that occurred in the pre-laboratory environment. The variability may also have been related to conditions within the laboratory, such as differences in the manner in which the subjects were taken from their home cages and placed in the chair, the fit of the chair, and other properties associated with the general experimental conditions. Although this variability and the reasons for it merit further investigation, the fact remains that biting during punishment was in all cases suppressed to a near-zero level.

The effectiveness of punishment in reducing the frequency of some arbitrarily chosen operant response is well documented (Azrin and Holz, 1966; Boe and Church, 1968). Critical variables involving the presentation of the punishing stimulus are the intensity, frequency, scheduling, and immediacy of the punishing stimulus. The effectiveness of the punishment procedure is related also to the deprivation level of the organism and the schedule of reinforcement involved in maintaining the operant response. The present investigation differed from other punishment studies in two aspects: (1) the punished response appears to have many respondent characteristics, and (2) whereas other studies were concerned with the suppression of behaviors conditioned and maintained by positive reinforcement, this study investigated the suppression of behavior produced and maintained by the same stimulus used to punish it.

Other studies have attempted to punish aggression, or a response leading to the opportunity for aggression. In these studies, however, the occurrence of the response was not directly related to the presentation of an eliciting stimulus. Myer and Baenninger (1966) found that some rats immediately killed mice, while in a similar situation, other rats did not engage in this behavior. When a foot-shock was delivered contingent upon an attack response, mouse-killing behavior in the "killer rats" was suppressed. When non-contingent shocks were presented to a "killer rat" after the killing behavior had been successfully suppressed, the killing behavior returned.

Studies investigating the effects of punishing an operant response that led to an opportunity for aggression have met with varying success. Using Siamese fighting fish, Melvin and Anson (1968) and Grabowski and Thompson (1968) reinforced a response that provided an opportunity for aggressive display with the presentation of a mirror image. Melvin and Anson found that when shock was delivered after this response, the response increased in frequency and thus allowed a more frequent display of aggression. Grabowski and Thompson found that a similar procedure suppressed the response, and that delayed punishment or non-contingent shocks delivered on a variable-interval schedule, increased the frequency of the response.

In another study involving aversive stimulation and aggression, Ulrich and Craine (1964) attempted to reinforce non-aggressive responses with shock termination. In this study, shock was presented and continued as long as aggressive responding occurred. Although non-aggressive responding was reinforced with shock termination, and continued aggression punished with continued shock, the time spent fighting increased. A possible explanation for this failure to suppress fighting is that neither the aggressive response that resulted in the continuation of shock, nor the non-aggressive response that resulted in shock termination, was sufficiently specific.

Although many factors remain to be studied, it appears that in cases where aggressive responses, or responses that provide an opportunity for

aggression, were successfully punished, the procedure included the immediate delivery of a response-contingent stimulus.

The eventual effectiveness of the punishment procedure in reducing the frequency of hose biting in the present investigation was evident. In certain instances, however, some facilitation of the aggressive response was noted. The data for Subjects 1 and 3 during the first session of the punishment phase (Sessions 34 and 81 respectively) show this effect. On these days, the subjects bit the hose directly after the start of the session. The resulting delivery of bite-contingent shock produced more hose biting. In most sessions, biting did not occur before delivery of the first scheduled shock. When biting did occur at this time, it never involved more than three or four bites. Although a facilitation in the amount of biting as a function of the bite-contingent shock occurred initially, the preponderant effect was a suppression of that response.

In addition to a temporary increase in responding during punishment, the use of shock to suppress shock-induced aggression produced other behaviors as well. As previously mentioned, when subjects were punished for each hose-biting response they ceased biting the hose, and instead frequently bit their fingers or sides, clawed at their face, or in other cases assumed a slumped, atypical posture. These behaviors all occurred only when shock was administered contingent upon a response. In short, although shock was effective in suppressing hose biting, the punishment of this particular response produced some side effects that suggest that still more research is needed into questions concerning the advisability of using punishment procedures in the control of behavior.

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7

AFFECTION

Affection is one of the most private of social behaviors, and as such, it is among the least amenable to scientific study. Affection is an emotional behavior. Emotions, as commonly defined, involve physiological changes, mainly endocrine, visceral, and autonomic. For example, in the internal manifestation of aggression, known as anger, adrenalin output, blood pressure, and heart rate increase. Some people insist that emotions have components that are nonphysiological but instead involve the "mind" or the "soul." From a behavioral point of view, whether the internal components of emotions are physical or nonphysical cannot be argued. The behaviorist cannot observe nonphysical phenomena and cannot see the internal physiology of emotion without attaching physiological recording devices that restrict the organism's behavior. In the study of emotion, then, the behavioral analyst is left, as usual, with observable behavior. He may study anger in terms of aggression, anxiety in terms of conditioned suppression, and affection in terms of behavior.

To the average person, the outward manifestation of emotion seems a poor substitute for the richly felt internal components. In our culture, internal emotional behavior is frequently characterized as either the source or the necessary mediator of observable emotional behavior. Someone is said to be provoked by an external stimulus, which causes him to feel anger, which in turn causes him to emit an observable response. Or, as seen in the preceding chapter, anger may be regarded as springing unaided from the "inside" of the person to express itself in aggression. Similarly, the external responses of affection seem to be mediated by the internal feelings of love. On the other hand, William James (1890, pp. 449ff) suggested a different emotional sequence. In James' view, external stimuli first produce the gross motor responses characteristic of the emotion. The physiological changes involved in the skeletal responses of emotion then produce the internal responses. An organism sees a dangerous stimulus and runs away; the running response then induces fear. For example, an unarmed man sees a bear and runs away; then he feels afraid. Or, perhaps, an aversive stimulus produces an aggressive

response, and the aggressive response then produces the feeling of anger. This view may at first seem as foreign as Chinese linguistics or the Italian bidding system, but it deserves consideration. In the past, few of the beliefs supported by intuition alone have survived scientific examination. However, empirical support for James' assertion may not be completely lacking. If you run from a friend who is feigning some mildly aggressive response, you may feel fear. If you criticize someone, you may feel more angry afterwards. Indeed, unrest within some social groups may spread as much through "bad mouthing" sessions as through responses to provoking stimuli. External behavior may, as James suggested, mediate internal emotional behavior. Or the environmental stimulus may concurrently produce both internal and external emotional behavior. No real reason exists for assuming that the internal aspect of emotion is its essence.

In any case, a behavioral approach to social emotions permits only the study of environmental stimuli and observable behavior. In the study of affection, therefore, the external behavior to be examined must be specified. In behavioral terms, affection may be defined as responding to obtain social reinforcement. One person is said to have affection for another if he behaves in a manner that would cause that person to emit socially reinforcing behavior. This definition may seem too narrow for the constellation of meaning encompassed by words such as "affection" or "love." For example, "giving" is often said to be a more important part of love than "receiving." Indeed, the behavior of conferring social reinforcement may be a part of affection. However, a scientific approach must begin with carefully restricted definitions.

Social and mutual reinforcement are both relevant to the study of affection and both have been examined in Chapters 3 and 2 of this volume. The papers included in the present chapters take more traditional approaches to affection. One paper discusses "love," another "social attachments," and the third "positive attitudes." At the base of all of these approaches to affection, however, is the notion that the affectionate organism will make a response to obtain reinforcement from the object of its affection.

The first paper included in this chapter is by H. F. Harlow and entitled "The nature of love." Harlow feels, as did Freud and other psychoanalytical theorizers, that affectional behavior is dependent on the nature of the early relationship between mother and child. However, Harlow approaches the assumption from an experimental point of view. In the work presented here, Harlow uses real infant monkeys and mechanical "mother" monkeys to examine the origin and endurance of affectional responses. Commonsense behaviorism suggests that the love that a child develops for its mother rests on the mother's satisfaction of the child's physiological needs. Initially, the child "loves" food that the mother feeds the child. Eventually the mother

becomes a conditioned reinforcer, and the child loves the mother as well. Since mothers dispense a variety of physiological reinforcers, mothers are likely to become powerful generalized reinforcers. Harlow's work shows that, in the rhesus monkey, tactile stimuli are far more important in inducing affectionate responses than is food. Since neonate monkeys sometimes die without such stimuli, the stimuli may be as physiologically necessary as food. Harlow uses a variety of behavioral measures of affection: time spent contacting the surrogate mother both with and without a "fear" stimulus; lever presses that result in an opportunity to look at the mother; and operating a puzzle box to obtain access to the mother.

A popular notion in the study of early social attachments is that of a "critical period" of time during which certain behaviors either develop or are never acquired. Especially in some species of birds, strong attachments appear to form only during certain hours after hatching. Similar critical periods have been proposed for various learned behaviors in various organisms (e.g. Scott, 1962). Harlow's work shows that, at least in the rhesus monkey, there is no absolutely critical period for the development of attachment. Previously isolated monkeys who were 250 days old when given experience with imitation mothers developed an attachment similar to those monkeys who had been with their surrogate mothers from birth.

The attachments developed by Harlow's monkeys were highly resistant to forgetting. Forgetting differs from extinction in that in forgetting a period elapses in which there is no opportunity to respond. In extinction, an animal makes numerous unreinforced responses. As contact with the mother was in itself reinforcing, the extinction of the contact response would have been impossible to measure. Operant responses are usually resistant to forgetting, and the affectional responses of Harlow's monkeys are no exception. The degree to which adult affectional responses are irrevocably determined by early experiences is still uncertain. As a later paper by Harlow presented in Chapter 9 will demonstrate, the early experiences of these monkeys did have a lasting effect on their social behavior. Whether such an effect always occurs, and whether the effect is beyond modification, is still open to question.

The second paper included in this chapter also studies the effect of early social experience on affectional behavior. The paper is by R. B. Cairns and D. L. Johnson and is entitled, "The development of interspecies social attachments." In the study, weaned lambs were housed with adult dogs. Although the lambs had no physical contact with the dogs, and, in addition, had preweaning experience with ewes, the lambs would enter the arm of a U maze that contained the dog, rather than the arm that contained a ewe. Later experience in a flock of sheep reversed this preference. Apparently for sheep there is no strong critical period for the formation of attachments.

Also, the tactile stimuli that were apparently so important to Harlow's monkeys were not important for the sheep. The attachment developed even though no contact was allowed between lambs and dogs. This study and its results are typical of studies of attachment behavior (Cairns, 1966). The factors affecting attachment are not analyzed in detail; simple exposure is the only variable manipulated in these studies. The results suggest that such exposure includes the interactions crucial to the formation of attachments.

Imprinting is a form of attachment that has received much attention. As mentioned previously, in some animals, mostly species of birds whose young are independent at hatching, strong attachments form only during certain hours after hatching. The attachments may form to a variety of animals and objects; the range of feasible stimuli varies from species to species. The imprinting attachment is apparently irreversible, although, to the editors' knowledge, no clear-cut demonstration of irreversibility has been made. Numerous theories have evolved to describe and explain imprinting (Verplanck, 1955; Hess, 1964). Generally, the imprinting stimulus is thought to be a prior "releasor" or "elicitor" of a response such as physically following the stimulus. Hess (1964) has proposed that the effort expended in the following response is necessary to the imprinting phenomenon. However, Collins (1965) has shown that imprinting will occur in chicks that are not allowed to follow the stimulus. Also, Campbell and Pickleman (1961) have shown that the imprinting object will reinforce, rather than release, the following response. Chicks would make each running response without any prior exposure to the imprinting stimulus. However, the response was *followed* by access to the stimulus. Of course, it is possible that the imprinting stimulus may act as both an eliciting and a reinforcing stimulus. A stimulus may acquire more than one type of control over a response. Aversive stimuli, for example, appear to have both an eliciting and a motivational role in aggression. However, the traditional characterization of imprinting as an instinctual process involving releasors is probably an oversimplification. Imprinting is a fascinating natural phenomenon and provides grist for the mill of those who feel most behavior is a function of instinct. On the other hand, the studies by Harlow and by Cairns and Johnson demonstrate that highly critical periods for the formation of attachments do not appear to exist for many animals. The imprinting phenomenon appears to be the exception rather than the rule.

Early experience is certainly important in the development of affectional behavior. However, the current experiences of older children and adults can also be important. The third paper presented in this chapter examines the role of contemporary experience in the formation of attachments. The study is by B. E. and A. J. Lott and is entitled, "The formation of positive attitudes toward group members." The work is couched in the learning theory of Hull, but the study is relevant to the approach of this volume. To begin with, two

sociometric tests were administered to groups of children taken from classrooms. In sociometric tests, each person in a group is usually asked to choose two other people whom he "likes" or with whom he would like to associate under certain conditions. From the responses, the patterns of association or "friendship" within the group can be charted. Although sociometric tests are questionnaire rather than behavioral tests, the response is a simple one. Lott and Lott noted marked consistency between the two preliminary sociometric tests. On the basis of the tests, the children were divided into groups of three. The groups were made up of children who had not chosen one another. These groups played a game in which the experimenter controlled the winning and losing. Winning was reinforced by obtaining a toy. After the game, a third (the final) sociometric test was administered. Considering the consistency of the two preliminary sociometric test results and the brief duration of the experiment relative to the general experience of the children, winning or losing the game had a disproportionate effect on the final sociometric test. Children who were winners were likely to choose children with whom they had played the game; the game-group members may have become stimuli discriminative for reinforcement, and hence, conditioned reinforcers. The study shows quite clearly that affectional behavior increases toward individuals with whom one has reinforcing experiences.

Affection is an emotional behavior that may be produced by reinforcement of affectional responses toward another organism, or simply by reinforcement in the presence of another organism. During infancy, certain types of reinforcement, such as tactile reinforcement, may have special importance. Also, affectional experiences during infancy may, as some insist, be crucial to the development of later affectional responses. However, some affectional responses are open to change by reinforcement and probably by other environmental factors that commonly control behavior. No matter what is discovered on a scientific level about love, human affectional emotions are likely to remain unchanged. Knowledge does not create or destroy, but only reveals. Knowledge of the physics of color and light, and of the physiology of vision, does not affect appreciation of a painting. Knowledge of geology and botany does not reduce the emotion-provoking qualities of a landscape. The study of emotions and, indeed, of any behavior should enhance human experience by permitting knowledge of the behavior at many different levels.

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The nature of love

Harry F. Harlow

Love is a wondrous state, deep, tender, and rewarding. Because of its intimate and personal nature it is regarded by some as an improper topic for experimental research. But, whatever our personal feelings may be, our assigned mission as psychologists is to analyze all facets of human and animal behavior into their component variables. So far as love or affection is concerned, psychologists have failed in this mission. The little we know about love does not transcend simple observation, and the little we write about it has been written better by poets and novelists. But of greater concern is the fact that psychologists tend to give progressively less attention to a motive which pervades our entire lives. Psychologists, at least psychologists who write textbooks, not only show no interest in the origin and development of love or affection, but they seem to be unaware of its very existence.

The apparent repression of love by modern psychologists stands in sharp contrast with the attitude taken by many famous and normal people. The word "love" has the highest reference frequency of any word cited in Bartlett's book of *Familiar Quotations*. It would appear that this emotion has long had a vast interest and fascination for human beings, regardless of the attitude taken by psychologists; but the quotations cited, even by famous and normal people, have a mundane redundancy. These authors and authorities have stolen love from the child and infant and made it the exclusive property of the adolescent and adult.

Thoughtful men, and probably all women, have speculated on the nature of love. From the developmental point of view, the general plan is quite

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Address of the President at the sixty-sixth Annual Convention of the American Psychological Association, Washington, D. C., August 31, 1958.

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clear: The initial love responses of the human being are those made by the infant to the mother or some mother surrogate. From this intimate attachment of the child to the mother, multiple learned and generalized affectional responses are formed.

Unfortunately, beyond these simple facts we know little about the fundamental variables underlying the formation of affectional responses and little about the mechanisms through which the love of the infant for the mother develops into the multifaceted response patterns characterizing love or affection in the adult. Because of the dearth of experimentation, theories about the fundamental nature of affection have evolved at the level of observation, intuition, and discerning guesswork, whether these have been proposed by psychologists, sociologists, anthropologists, physicians, or psychoanalysts.

The position commonly held by psychologists and sociologists is quite clear: The basic motives are, for the most part, the primary drives—particularly hunger, thirst, elimination, pain, and sex—and all other motives, including love or affection, are derived or secondary drives. The mother is associated with the reduction of the primary drives—particularly hunger, thirst, and pain—and through learning, affection or love is derived.

It is entirely reasonable to believe that the mother through association with food may become a secondary-reinforcing agent, but this is an inadequate mechanism to account for the persistence of the infant-maternal ties. There is a spate of researches on the formation of secondary reinforcers to hunger and thirst reduction. There can be no question that almost any external stimulus can become a secondary reinforcer if properly associated with tissue-need reduction, but the fact remains that this redundant literature demonstrates unequivocally that such derived drives suffer relatively rapid experimental extinction. Contrariwise, human affection does not extinguish when the mother ceases to have intimate association with the drives in question. Instead, the affectional ties to the mother show a lifelong, unrelenting persistence and, even more surprising, widely expanding generality.

Oddly enough, one of the few psychologists who took a position counter to modern psychological dogma was John B. Watson, who believed that love was an innate emotion elicited by cutaneous stimulation of the erogenous zones. But experimental psychologists, with their peculiar propensity to discover facts that are not true, brushed this theory aside by demonstrating that the human neonate had no differentiable emotions, and they established a fundamental psychological law that prophets are without honor in their own profession.

The psychoanalysts have concerned themselves with the problem of the nature of the development of love in the neonate and infant, using ill and aging human beings as subjects. They have discovered the overwhelming importance of the breast and related this to the oral erotic tendencies developed at an age preceding their subject's memories. Their theories range from a belief that the infant has an innate need to achieve and suckle at the breast to beliefs not

unlike commonly accepted psychological theories. There are exceptions, as seen in the recent writings of John Bowlby, who attributes importance not only to food and thirst satisfaction, but also to "primary object-clinging," a need for intimate physical contact, which is initially associated with the mother.

As far as I know, there exists no direct experimental analysis of the relative importance of the stimulus variables determining the affectional or love responses in the neonatal and infant primate. Unfortunately, the human neonate is a limited experimental subject for such researches because of his inadequate motor capabilities. By the time the human infant's motor responses can be precisely measured, the antecedent determining conditions cannot be defined, having been lost in a jumble and jungle of confounded variables.

Many of these difficulties can be resolved by the use of the neonatal and infant macaque monkeys as the subject for the analysis of basic affectional variables. It is possible to make precise measurements in this primate beginning at two to ten days of age, depending upon the maturational status of the individual animal at birth. The macaque infant differs from the human infant in that the monkey is more mature at birth and grows more rapidly; but the basic responses relating to affection, including nursing, contact, clinging, and even visual and auditory exploration, exhibit no fundamental differences in the two species. Even the development of perception, fear, frustration, and learning capability follows very similar sequences in rhesus monkeys and human children.

Three years' experimentation before we started our studies on affection gave us experience with the neonatal monkey. We had separated more than 60 of these animals from their mothers 6 to 12 hours after birth and suckled them on tiny bottles. The infant mortality was only a small fraction of what would have obtained had we let the monkey mothers raise their infants. Our bottle-fed babies were healthier and heavier than monkey-mother-reared infants. We know that we are better monkey mothers than are real monkey mothers thanks to synthetic diets, vitamins, iron extracts, penicillin, chloromycetin, 5% glucose, and constant, tender, loving care.

During the course of these studies we noticed that the laboratory-raised babies showed strong attachment to the cloth pads (folded gauze diapers) which were used to cover the hardware-cloth floors of their cages. The infants clung to these pads and engaged in violent temper tantrums when the pads were removed and replaced for sanitary reasons. Such contact-need or responsiveness had been reported previously by Gertrude van Wagenen for the monkey and by Thomas McCulloch and George Haslerud for the chimpanzee and is reminiscent of the devotion often exhibited by human infants to their pillows, blankets, and soft, cuddly stuffed toys. Responsiveness by the one-day-old infant monkey to the cloth pad is shown in Figure 7-1, and an unusual and strong attachment of a six-month-old infant to the cloth pad is

Figure 7–1. Response to cloth pad by one-day-old monkey.

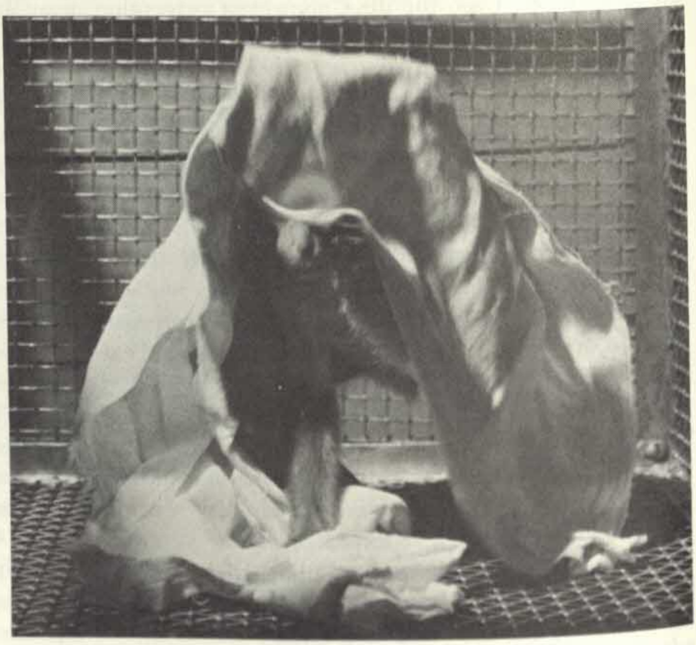


Figure 7–2. Response to gauze pad by six-month-old monkey used in earlier study.

illustrated in Figure 7–2. The baby, human or monkey, if it is to survive, must clutch at more than a straw.

We had also discovered during some allied observational studies that a baby monkey raised on a bare wire-mesh cage floor survives with difficulty, if at all, during the first five days of life. If a wire-mesh cone is introduced, the baby does better; and, if the cone is covered with terry cloth, husky, healthy, happy babies evolve. It takes more than a baby and a box to make a normal monkey. We were impressed by the possibility that, above and beyond the bubbling fountain of breast or bottle, contact comfort might be a very important variable in the development of the infant's affection for the mother.

At this point we decided to study the development of affectional responses of neonatal and infant monkeys to an artificial, inanimate mother, and so we built a surrogate mother which we hoped and believed would be a

Figure 7–3. Cloth mother surrogate.

good surrogate mother. In devising this surrogate mother we were dependent neither upon the capriciousness of evolutionary processes nor upon mutations produced by chance radioactive fallout. Instead, we designed the mother surrogate in terms of modern human-engineering principles (Figure 7-3). We produced a perfectly proportioned, streamlined body stripped of unnecessary bulges and appendices. Redundancy in the surrogate mother's sytem was avoided by reducing the number of breasts from two to one and placing this unibreast in an upper-thoracic, sagittal position, thus maximizing the natural and known perceptual-motor capabilities of the infant operator. The surrogate was made from a block of wood, covered with sponge rubber, and sheathed

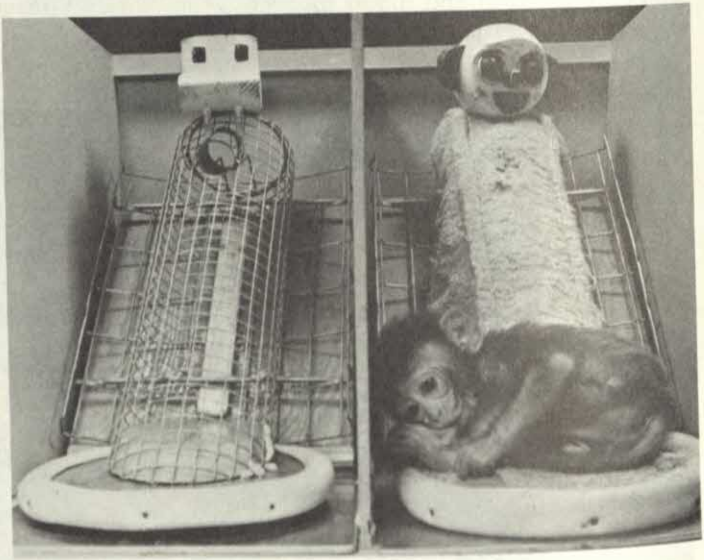


Figure 7-4. Wire and cloth mother surrogates.

in tan cotton terry cloth. A light bulb behind her radiated heat. The result was a mother, soft, warm, and tender, a mother with infinite patience, a mother available twenty-four hours a day, a mother that never scolded her infant and never struck or bit her baby in anger. Furthermore, we designed a mother-machine with maximal maintenance efficiency since failure of any system or function could be resolved by the simple substitution of black boxes and new component parts. It is our opinion that we engineered a very superior monkey mother, although this position is not held universally by the monkey fathers.

Before beginning our initial experiment we also designed and constructed a second mother surrogate, a surrogate in which we deliberately built less than

the maximal capability for contact comfort. This surrogate mother is illustrated in Figure 7-4. She is made of wire-mesh, a substance entirely adequate to provide postural support and nursing capability, and she is warmed by radiant heat. Her body differs in no essential way from that of the cloth mother surrogate other than in the quality of the contact comfort which she can supply.

In our initial experiment, the dual mother-surrogate condition, a cloth mother and a wire mother were placed in different cubicles attached to the infant's living cage as shown in Figure 7-4. For four newborn monkeys the cloth mother lactated and the wire mother did not; and, for the other four, this condition was reversed. In either condition the infant received all its milk through the mother surrogate as soon as it was able to maintain itself in this way, a capability achieved within two or three days except in the case of very immature infants. Supplementary feedings were given until the milk intake from the mother surrogate was adequate. Thus, the experiment was designed as a test of the relative importance of the variables of contact comfort and nursing comfort. During the first 14 days of life the monkey's cage floor was covered with a heating pad wrapped in a folded gauze diaper, and thereafter the cage floor was bare. The infants were always free to leave the heating pad or cage floor to contact either mother, and the time spent on the surrogate mothers was automatically recorded. Figure 7-5 shows the total

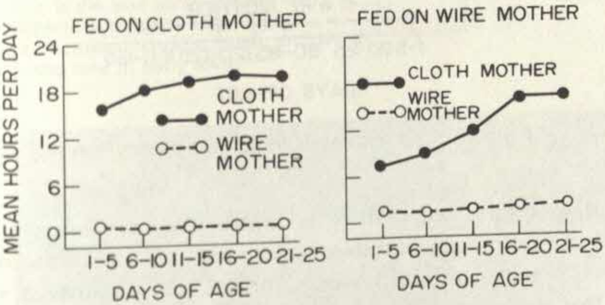


Figure 7-5. Time spent on cloth and wire mother surrogates.

time spent on the cloth and wire mothers under the two conditions of feeding. These data make it obvious that contact comfort is a variable of overwhelming importance in the development of affectional responses, whereas lactation is a variable of negligible importance. With age and opportunity to learn, subjects with the lactating wire mother showed decreasing responsiveness to her and increasing responsiveness to the nonlactating cloth mother, a finding completely contrary to any interpretation of derived drive in which the mother-form becomes conditioned to hunger-thirst reduction. The persistence of

these differential responses throughout 165 consectutive days of testing is evident in Figure 7-6.

One control group of neonatal monkeys was raised on a single wire mother, and a second control group was raised on a single cloth mother. There were no differences between these two groups in amount of milk ingested or in weight gain. The only difference between the groups lay in the composition of the feces, the softer stools of the wire-mother infants suggesting psychosomatic involvement. The wire mother is biologically adequate but psychologically inept.

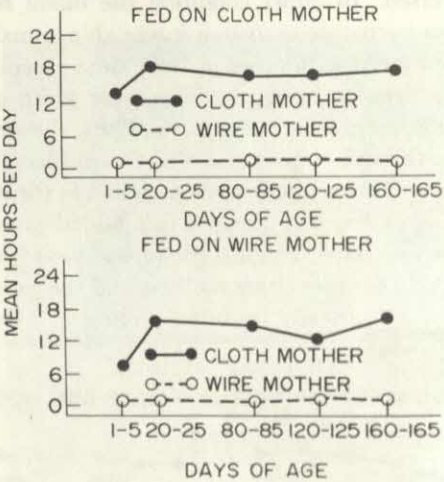


Figure 7-6. Long-term contact time on cloth and wire mother surrogates.

We are not surprised to discover that contact comfort was an important basic affectional or love variable, but we did not expect it to overshadow so completely the variable of nursing; indeed, the disparity is so great as to suggest that the primary function of nursing as an affectional variable is that of insuring frequent and intimate body contact of the infant with the mother. Certainly, man cannot live by milk alone. Love is an emotion that does not need to be bottle- or spoon-fed, and we may be sure that there is nothing to be gained by giving lip service to love.

A charming lady once heard me describe these experiments; and, when I subsequently talked to her, her face brightened with sudden insight: "Now I know what's wrong with me," she said, "I'm just a wire mother." Perhaps she was lucky. She might have been a wire wife.

We believe that contact comfort has long served the animal kingdom as a motivating agent for affectional responses. Since at the present time we have

no experimental data to substantiate this position, we supply information which must be accepted, if at all, on the basis of face validity:

—From *Look,* August 19, 1958

The Hippopotamus

This is the skin some babies feel
Replete with hippo love appeal.
Each contact, cuddle, push, and shove
Elicits tons of baby love.

—From *Zoo Guide*, Zoological Society of London

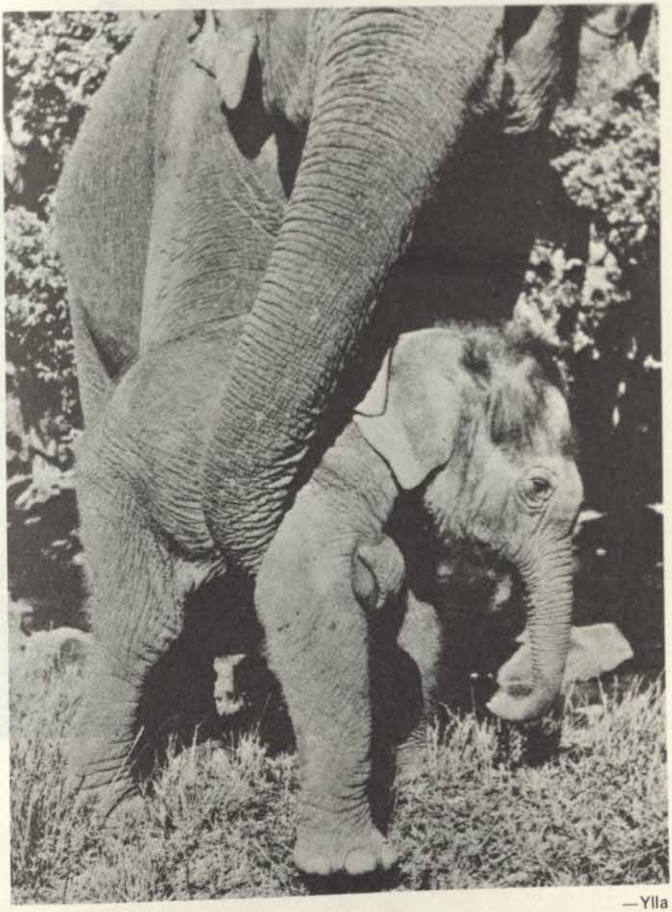
The Rhinocerus

The rhino's skin is thick and tough,
And yet this skin is soft enough
That baby rhinos always sense.
A love enormous and intense.

From *All About Snakes*, E. M. Hale & Co.

The Snake

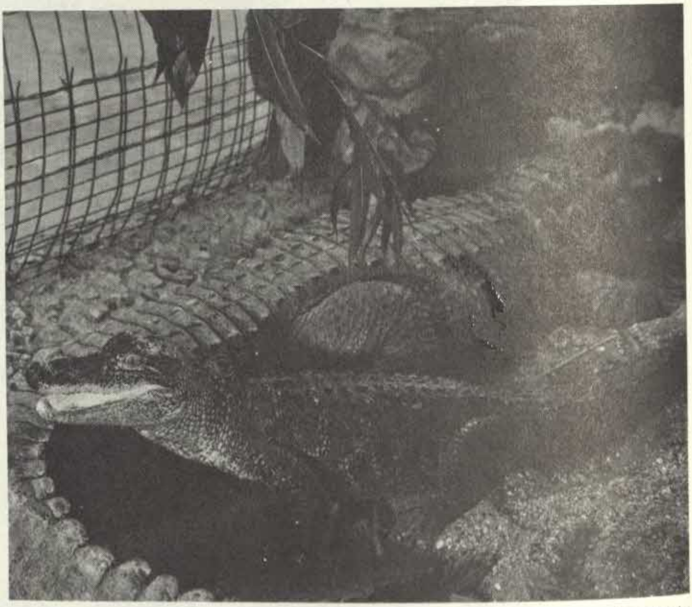
To baby vipers, scaly skin
Engenders love 'twixt kith and kin.
Each animal by God is blessed
With kind of skin it loves the best.



—Ylla

The Elephant

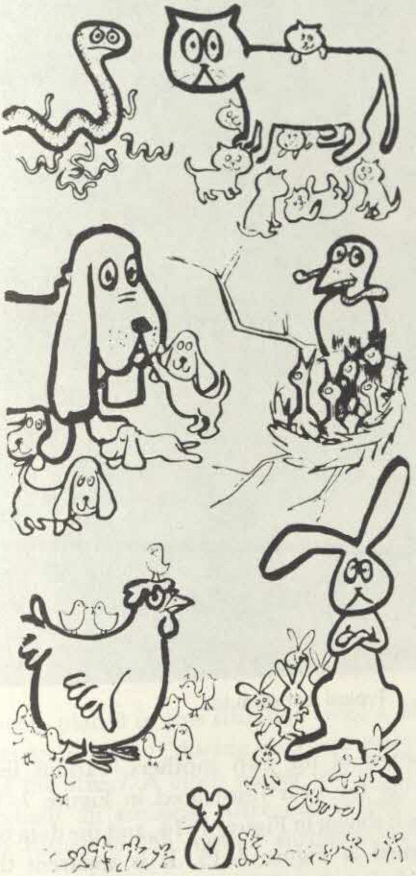
Though mother may be short on arms,
Her skin is full of warmth and charms.
And mother's touch on baby's skin
Endears the heart that beats within.



—Sponholz

The Crocodile

Here is the skin they love to touch.
It isn't soft and there isn't much,
But its contact comfort will beguile
Love from the infant crocodile.



You see, all God's chillun's got skin.

One function of the real mother, human or sub-human, and presumably of a mother surrogate, is to provide a haven of safety for the infant in times of fear and danger. The frightened or ailing child clings to its mother, not its father; and this selective responsiveness in times of distress, disturbance, or danger may be used as a measure of the strength of affectional bonds. We have tested this kind of differential responsiveness by presenting to the infants in

Figure 7–13. Typical fear stimulus.

their cages, in the presence of the two mothers, various fear-producing stimuli such as the moving toy bear illustrated in Figure 7-13. A typical response to a fear stimulus is shown in Figure 7–14, and the data on differential responsiveness are presented in Figure 7-15. It is apparent that the cloth mother is highly preferred over the wire one, and this differential selectivity is enhanced by age and experience. In this situation, the variable of nursing appears to be of absolutely no importance: the infant consistently seeks the soft mother surrogate regardless of nursing condition.

Similarly, the mother or mother surrogate provides its young with a source of security, and this role or function is seen with special clarity when mother and child are in a strange situation. At the present time we have completed tests for this relationship on four of our eight baby monkeys assigned to the dual mother-surrogate condition by introducing them for three minutes into the strange environment of a room measuring six feet by six feet by six feet (also called the "open-field test") and containing multiple stimuli known to elicit curiosity-manipulatory responses in baby monkeys.

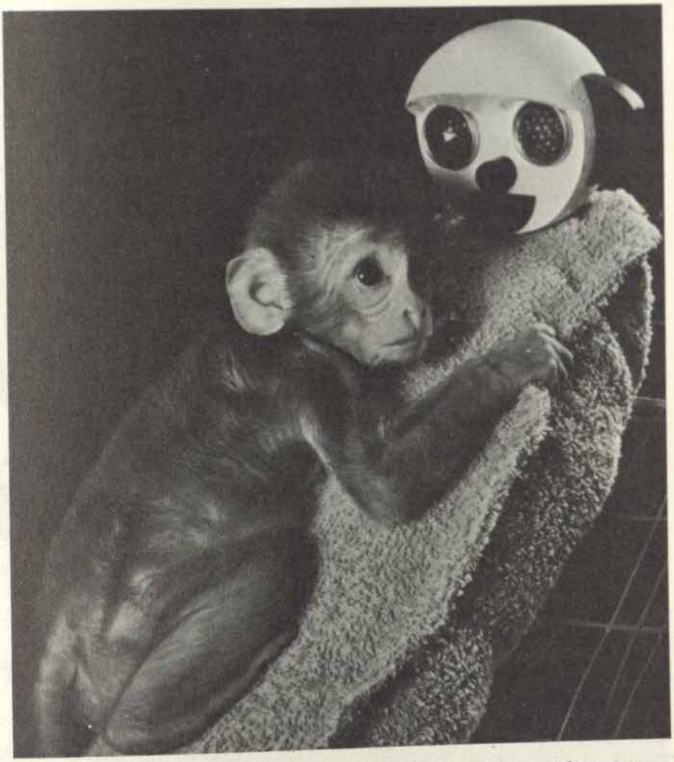


Figure 7-14. Typical response to cloth mother surrogate in fear test.

The subjects were placed in this situation twice a week for eight weeks with no mother surrogate present during alternate sessions and the cloth mother present during the others. A cloth diaper was always available as one of the stimuli throughout all sessions. After one or two adaptation sessions, the infants always rushed to the mother surrogate when she was present and

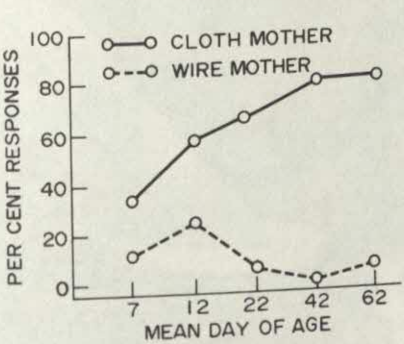


Figure 7-15. Differential responsiveness in fear tests.

Figure 7–16. Response to cloth mother in the open-field test.

clutched her, rubbed their bodies against her, and frequently manipulated her body and face. After a few additional sessions, the infants began to use the mother surrogate as a source of security, a base of operations. As is shown in Figures 7–16 and 7–17, they would explore and manipulate a stimulus and then return to the mother before adventuring again into the strange new world. The behavior of these infants was quite different when the mother was absent from the room. Frequently they would freeze in a crouched position,

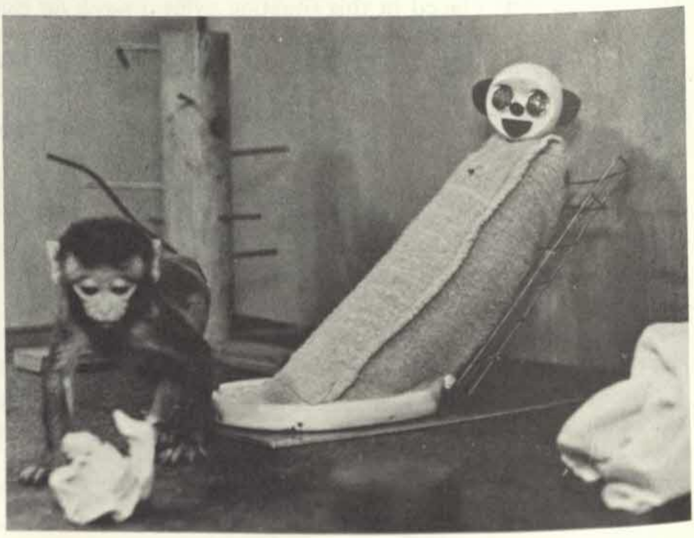


Figure 7–17. Object exploration in presence of cloth mother.

Figure 7–18. Response in the open-field test in the absence of the mother surrogate.

Figure 7–19. Response in the open-field test in the absence of the mother surrogate.

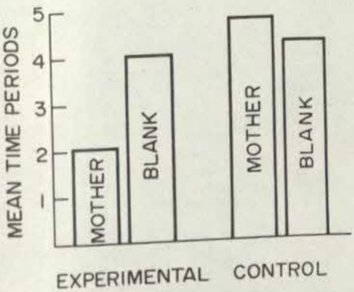


Figure 7–20. Emotionality index with and without the presence of the cloth mother.

as is illustrated in Figures 7–18 and 7–19. Emotionality indices such as vocalization, crouching, rocking, and sucking increased sharply, as shown in Figure 7–20. Total emotionality score was cut in half when the mother was present. In the absence of the mother some of the experimental monkeys would rush to

the center of the room where the mother was customarily placed and then run rapidly from object to object, screaming and crying all the while. Continuous, frantic clutching of their bodies was very common, even when not in the crouching position. These monkeys frequently contacted and clutched the cloth diaper, but this action never pacified them. The same behavior occurred in the presence of the wire mother. No difference between the cloth-mother-fed and wire-mother-fed infants was demonstrated under either condition. Four control infants never raised with a mother surrogate showed the same emotionality scores when the mother was absent as the experimental infants showed in the absence of the mother, but the controls' scores were slightly larger in the presence of the mother surrogate than in her absence.

Some years ago Robert Butler demonstrated that mature monkeys enclosed in a dimly lighted box would open and reopen a door hour after hour for no other reward than that of looking outside the box. We now have

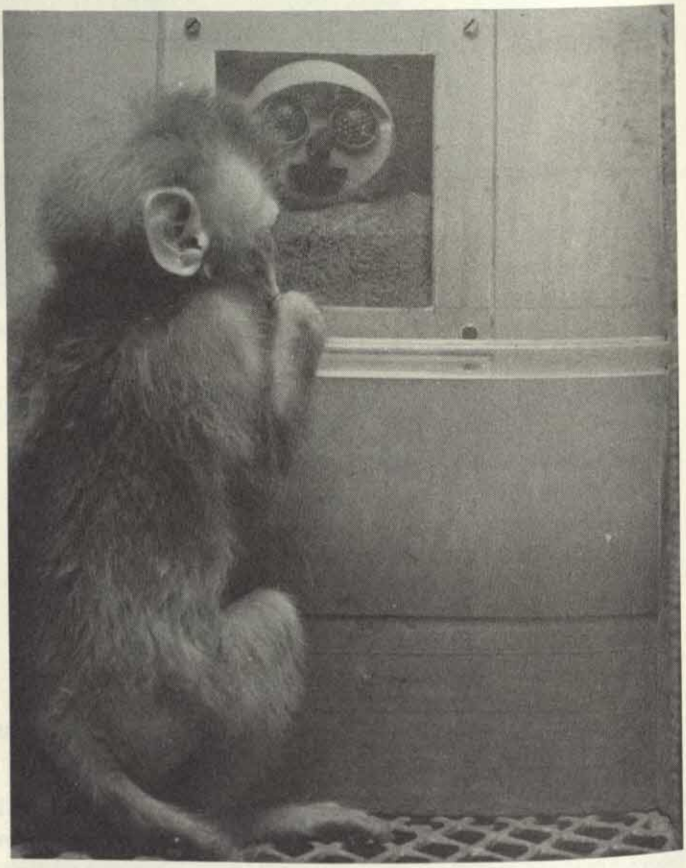


Figure 7–21. Visual exploration apparatus.

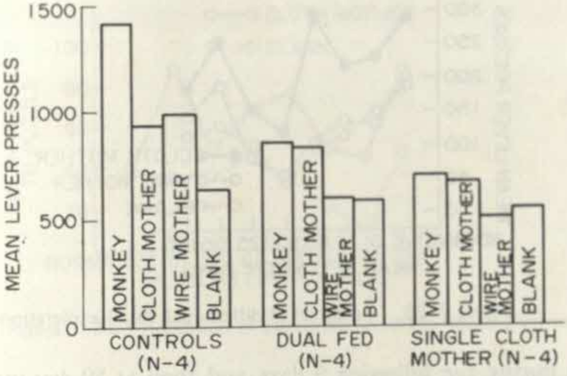


Figure 7-22. Differential responses to visual exploration.

data indicating that neonatal monkeys show this same compulsive visual curiosity on their first test day in an adaptation of the Butler apparatus which we call the "love machine," an apparatus designed to measure love. Usually these tests are begun while the monkey is 10 days of age, but this same persistent visual exploration has been obtained in a three-day-old monkey during the first half-hour of testing. Butler also demonstrated that rhesus monkeys show selectivity in rate and frequency of door-opening to stimuli of differential attractiveness in the visual field outside the box. We have utilized this principle of response selectivity by the monkey to measure strength of affectional responsiveness in our infants in the baby version of the Butler box. The test sequence involves four repetitions of a test battery in which four stimuli—cloth mother, wire mother, infant monkey, and empty box—are presented for a 30-minute period on successive days. The first four subjects in the dual mother-surrogate group were given a single test sequence at 40 to 50 days of age, depending upon the availability of the apparatus, and only their data are presented. The second set of four subjects is being given repetitive tests to obtain information relating to the development of visual exploration. The apparatus is illustrated in Figure 7-21. The data obtained from the first four infants raised with the two mother surrogates are presented in the middle graph of Figure 7-22 and show approximately equal responding to the cloth mother and another infant monkey, and no greater responsiveness to the wire mother than to an empty box. Again, the results are independent of the kind of mother that lactated, cloth or wire. The same results are found for a control group raised, but not fed, on a single cloth mother; these data appear in the graph on the right. Contrariwise, the graph on the left shows no differential responsiveness to cloth and wire mothers by a second control group, which was not raised on any mother surrogate. We can be certain that not all love is blind.

The first four infant monkeys in the dual mother-surrogate group were separated from their mothers between 165 and 170 days of age and tested for

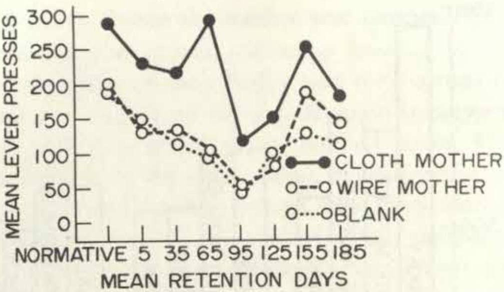


Figure 7-23. Retention of differential visual-exploration responses.

retention during the following 9 days and then at 30-day intervals for six successive months. Affectional retention as measured by the modified Butler box is given in Figure 7-23. In keeping with the data obtained on adult monkeys by Butler, we find a high rate of responding to any stimulus, even the empty box. But throughout the entire 185-day retention period there is a consistent and significant difference in response frequency to the cloth mother contrasted with either the wire mother or the empty box, and no consistent difference between wire mother and empty box.

Affectional retention was also tested in the open field during the first 9 days after separation and then at 30-day intervals, and each test condition was run twice at each retention interval. The infant's behavior differed from that observed during the period preceding separation. When the cloth mother was present in the post-separation period, the babies rushed to her, climbed up, clung tightly to her, and rubbed their heads and faces against her body. After this initial embrace and reunion, they played on the mother, including biting and tearing at her cloth cover; but they rarely made any attempt to leave her during the test period, nor did they manipulate or play with the objects in the room, in contrast with their behavior before maternal separation. The only exception was the occasional monkey that left the mother surrogate momentarily, grasped the folded piece of paper (one of the standard stimuli in the field), and brought it quickly back to the mother. It appeared that deprivation had enhanced the tie to the mother and rendered the contact-comfort need so prepotent that need for the mother overwhelmed the exploratory motives during the brief, three-minute test sessions. No change in these behaviors was observed throughout the 185-day period. When the mother was absent from the open field, the behavior of the infants was similar in the initial retention test to that during the preseparation tests; but they tended to show gradual adaptation to the open-field situation with repeated testing and, consequently, a reduction in their emotionality scores.

In the last five retention test periods, an additional test was introduced in which the surrogate mother was placed in the center of the room and covered with a clear Plexiglas box. The monkeys were initially disturbed and frustrated

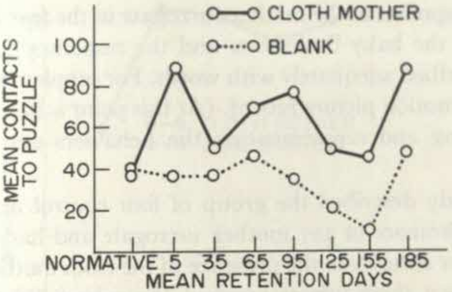


Figure 7–24. Retention of puzzle manipulation responsiveness.

when their explorations and manipulations of the box failed to provide contact with the mother. However, all animals adapted to the situation rather rapidly. Soon they used the box as a place of orientation for exploratory and play behavior, made frequent contacts with the objects in the field, and very often brought these objects to the Plexiglas box. The emotionality index was slightly higher than in the condition of the available cloth mothers, but it in no way approached the emotionality level displayed when the cloth mother was absent. Obviously, the infant monkeys gained emotional security by the presence of the mother even though contact was denied.

Affectional retention has also been measured by tests in which the monkey must unfasten a three-device mechanical puzzle to obtain entrance into a compartment containing the mother surrogate. All the trials are initiated by allowing the infant to go through an unlocked door, and in half the trials it finds the mother present and in half, an empty compartment. The door is then locked and a ten-minute test conducted. In tests given prior to separation from the surrogate mothers, some of the infants had solved this puzzle and others had failed. The data of Figure 7–24 show that on the last test before separation there were no differences in total manipulation under mother-present and mother-absent conditions, but striking differences exist between the two conditions throughout the post-separation test periods. Again, there is no interaction with conditions of feeding.

The overall picture obtained from surveying the retention data is unequivocal. There is little, if any, waning of responsiveness to the mother throughout this five-month period as indicated by any measure. It becomes perfectly obvious that this affectional bond is highly resistant to forgetting and that it can be retained for very long periods of time by relatively infrequent contact reinforcement. During the next year, retention tests will be conducted at 90-day intervals, and further plans are dependent upon the results obtained. It would appear that affectional responses may show as much resistance to extinction as has been previously demonstrated for learned fears and learned pain, and such data would be in keeping with those of common human observation.

The infant's responses to the mother surrogate in the fear tests, the open-field situation, and the baby Butler box and the responses on the retention tests cannot be described adequately with words. For supplementary information we turn to the motion picture record. (At this point a 20-minute film was presented illustrating and supplementing the behaviors described thus far in the address).

We have already described the group of four control infants that had never lived in the presence of any mother surrogate and had demonstrated no sign of affection or security in the presence of the cloth mothers introduced in test sessions. When these infants reached the age of 250 days, cubicles containing both a cloth mother and a wire mother were attached to their cages. There was no lactation in these mothers, for the monkeys were on a solid-food diet. The initial reaction of the monkeys to the alterations was one of extreme disturbance. All the infants screamed violently and made repeated attempts to escape the cage whenever the door was opened. They kept a maximum distance from the mother surrogates and exhibited a considerable amount of rocking and crouching behavior, indicative of emotionality. Our first thought was that the critical period for the development of maternally directed affection had passed and that these macaque children were doomed to live as affectional orphans. Fortunately, these behaviors continued for only 12 to 48 hours and then gradually ebbed, changing from indifference to active contact on, and exploration of, the surrogates. The home-cage behavior of these control monkeys slowly became similar to that of the animals raised with the mother surrogates from birth. Their manipulation and play on the cloth mother became progressively more vigorous to the point of actual mutilation, particularly during the morning after the cloth mother had been given her daily change of terry covering. The control subjects were now actively running to the cloth mother when frightened and had to be coaxed from her to be taken from the cage for formal testing.

Objective evidence of these changing behaviors is given in Figure 7-25, which plots the amount of time these infants spent on the mother surrogates. Within 10 days mean contact time is approximately nine hours, and this measure remains relatively constant throughout the next 30 days. Consistent with the results on the subjects reared from birth with dual mothers, these late-adopted infants spent less than one and one-half hours per day in contact with wire mothers, and this activity level was relatively constant throughout the test sessions. Although the maximum time that the control monkeys spent on the cloth mother was only about half that spent by the original dual mother-surrogate group, we cannot be sure that this discrepancy is a function of differential early experience. The control monkeys were about three months older when the mothers were attached to their cages than the experimental animals had been when their mothers were removed and the retention tests begun. Thus, we do not know what the amount of contact would be for a 250-day-old animal raised from birth with surrogate mothers. Nevertheless, the magnitude of the differences and the fact that the contact-

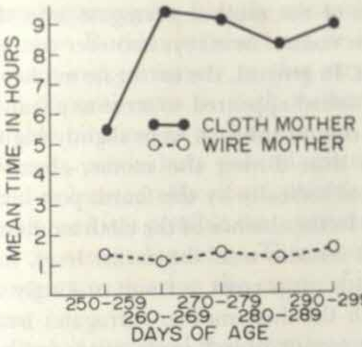


Figure 7-25. Differential time spent on cloth and wire mother surrogates by monkeys started at 250 days of age.

time curves for the mothered-from-birth infants had remained constant for almost 150 days suggest that early experience with the mother is a variable of measurable importance.

The control group has also been tested for differential visual exploration after the introduction of the cloth and wire mothers; these behaviors are plotted in Figure 7-26. By the second test session, a high level of exploratory behavior had developed, and the responsiveness to the wire mother and the empty box is significantly greater than that to the cloth mother. This is probably not an artifact since there is every reason to believe that the face of the cloth mother is a fear stimulus to most monkeys that have not had extensive experience with this object during the first 40 to 60 days of life. Within the third test session a sharp change in trend occurs, and the cloth mother is then more frequently viewed than the wire mother or the blank box; this trend continues during the fourth session, producing a significant preference for the cloth mother.

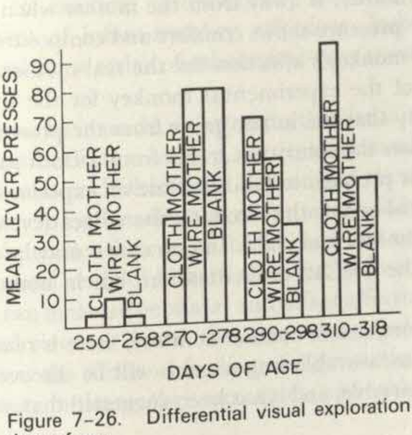


Figure 7-26. Differential visual exploration of monkeys started at 250 days of age.

Before the introduction of the mother surrogate into the home-cage situation, only one of the four control monkeys had ever contacted the cloth mother in the open-field tests. In general, the surrogate mother not only gave the infants no security, but instead appeared to serve as a fear stimulus. The emotionality scores of these control subjects were slightly higher during the mother-present test sessions than during the mother-absent test sessions. These behaviors were changed radically by the fourth post-introduction test approximately 60 days later. In the absence of the cloth mothers the emotionality index in this fourth test remains near the earlier level, but the score is reduced by half when the mother is present, a result strikingly similar to that found for infants raised with the dual mother-surrogates from birth. The control infants now show increasing object exploration and play behavior, and they begin to use the mother as a base of operations, as did the infants raised from birth with the mother surrogates. However, there are still definite differences in the behavior of the two groups. The control infants do not rush directly to the mother and clutch her violently; but instead they go toward, and orient around, her, usually after an initial period during which they frequently show disturbed behavior, exploratory behavior, or both.

That the control monkeys develop affection or love for the cloth mother when she is introduced into the cage at 250 days of age cannot be questioned. There is every reason to believe, however, that this interval of delay depresses the intensity of the affectional response below that of the infant monkeys that were surrogate-mothered from birth onward. In interpreting these data it is well to remember that the control monkeys had had continuous opportunity to observe and hear other monkeys housed in adjacent cages and that they had had limited opportunity to view and contact surrogate mothers in the test situations, even though they did not exploit the opportunities.

During the last two years we have observed the behavior of two infants raised by their own mothers. Love for the real mother and love for the surrogate mother appear to be very similar. The baby macaque spends many hours a day clinging to its real mother. If away from the mother when frightened, it rushes to her and in her presence shows comfort and composure. As far as we can observe, the infant monkey's affection for the real mother is strong, but no stronger than that of the experimental monkey for the surrogate cloth mother, and the security that the infant gains from the presence of the real mother is no greater than the security it gains from a cloth surrogate. Next year we hope to put this problem to final, definitive, experimental test. But, whether the mother is real or a cloth surrogate, there does develop a deep and abiding bond between mother and child. In one case it may be the call of the wild and in the other the McCall of civilization, but in both cases there is "togetherness."

In spite of the importance of contact comfort, there is reason to believe that other variables of measurable importance will be discovered. Postural support may be such a variable, and it has been suggested that, when we build

arms into the mother surrogate, 10 is the minimal number required to provide adequate child care. Rocking motion may be such a variable, and we are comparing rocking and stationary mother surrogates and inclined planes. The differential responsiveness to cloth mother and cloth-covered inclined plane suggests that clinging as well as contact is an affectional variable of importance. Sounds, particularly natural, maternal sounds, may operate as either unlearned or learned affectional variables. Visual responsiveness may be such a variable, and it is possible that some semblance of visual imprinting may develop in the neonatal monkey. There are indications that this becomes a variable of importance during the course of infancy through some maturational process.

John Bowlby has suggested that there is an affectional variable which he calls "primary object following," characterized by visual and oral search of the mother's face. Our surrogate-mother-raised baby monkeys are at first inattentive to her face, as are human neonates to human mother faces. But by 30 days of age ever-increasing responsiveness to the mother's face appears —whether through learning, maturation, or both—and we have reason to believe that the face becomes an object of special attention.

Our first surrogate-mother-raised baby had a mother whose head was just a ball of wood since the baby was a month early and we had not had time to design a more esthetic head and face. This baby had contact with the blank-faced mother for 180 days and was then placed with two cloth mothers, one motionless and one rocking, both being endowed with painted, ornamented faces. To our surprise the animal would compulsively rotate both faces 180 degrees so that it viewed only a round, smooth face and never the painted, ornamented face. Furthermore, it would do this as long as the patience of the experimenter in reorienting the faces persisted. The monkey showed no sign of fear or anxiety, but it showed unlimited persistance. Subsequently it improved its technique, compulsively removing the heads and rolling them into its cage as fast as they were returned. We are intrigued by this observation, and we plan to examine systematically the role of the mother face in the development of infant-monkey affections. Indeed, these observations suggest the need for a series of ethological-type researches on the two-faced female.

Although we have made no attempts thus far to study the generalization of infant-macaque affection or love, the techniques which we have developed offer promise in this uncharted field. Beyond this, there are few if any technical difficulties in studying the affection of the actual, living mother for the child, and the techniques developed can be utilized and expanded for the analysis and developmental study of father-infant and infant-infant affection.

Since we can measure neonatal and infant affectional responses to mother surrogates, and since we know they are strong and persisting, we are in a position to assess the effects of feeding and contactual schedules; consistency and inconsistency in the mother surrogates; and early, intermediate, and late

maternal deprivation. Again, we have here a family of problems of fundamental interest and theoretical importance.

If the researches completed and proposed make a contribution, I shall be grateful; but I have also given full thought to possible practical applications. The socioeconomic demands of the present and the threatened socioeconomic demands of the future have led the American woman to displace, or threaten to displace, the American man in science and industry. If this process continues, the problem of proper child-rearing practices faces us with startling clarity. It is cheering in view of this trend to realize that the American male is physically endowed with all the really essential equipment to compete with the American female on equal terms in one essential activity: the rearing of infants. We now know that women in the working classes are not needed in the home because of their primary mammalian capabilities: and it is possible that in the foreseeable future neonatal nursing will not be regarded as a necessity, but as a luxury—to use Veblen's term—a form of conspicuous consumption limited perhaps to the upper classes. But whatever course history may take, it is comforting to know that we are now in contact with the nature of love.

The development of interspecies social attachments

Robert B. Cairns
and
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PROBLEM

Studies of immature mammals have demonstrated the significant effects of prolonged isolation on the development of social responses. One of the most interesting observations has been that animals reared in isolation later exhibit asocial response patterns, i.e., they remain aloof from members of their species even when opportunities for interaction become available (Harlow, 1962; Scott, 1962).

Discussions of this phenomenon have typically focussed upon the negative

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features of the experimentally produced environments; namely, the absence of social stimuli which are normally present. It seems reasonable to propose, however, that some attention should be given to the cues that are available in the "isolation" setting. Not only have "isolated" animals been deprived of interaction experiences, but equally important, they have been exposed to different patterns of environmental cues. Certain of these cues, by virtue of their saliency and constancy, might be expected to take on significant elicitory and discriminatory properties for the developing organism.

The present interspecies rearing experiment was conducted to test one implication of the above proposal. It was expected that extended isolation of a young lamb from contact with other sheep, coupled with continuous exposure to an animal of an alien species, would significantly alter the cue properties of the latter animal. After a period of continuous confinement, then, the abrupt removal of the cohabitant (alien animal) should be correlated with significant behavioral disruption; and the cohabitant's return should be associated with a cessation of disruption. It would also follow that the lamb would acquire responses which were instrumental to reinstating the presence of the cohabitant.

Method

Eight Dorset lambs served as Ss; four Rambouillet ewes and four mature female collies were cohabitants. The lambs were 12-13 weeks old at the beginning of the experimental confinement.

Lambs were assigned at random to a ewe or canine. The resultant pairs were confined together for 24 hr. a day over 105 days. Each of the eight living compartments was 8 ft × 10 ft, enclosed on all sides. During this period the lambs were permitted no contact with other animals. While the ewe-lamb pairs were permitted to interact without restriction, three of the four canine-lamb pairs were continuously separated: the lamb was placed on one side of a wire fence which extended down the midline of the compartment and the dog on the other. This procedure was followed because three of the canines had attacked the lambs with which they had been paired. The separations were completed during the first week of confinement.

After 63 (± 2) days of confinement, the eight lambs were tested in the U-maze. In the first, the non-contrast series, one goal compartment was empty and the other contained the animal with which the lamb had been housed. Prior to the first test trial, each lamb was forced twice to either goal area. The non-correction method was used in the regular test series: as soon as the lamb entered either arm, a guillotine door was dropped, and the lamb was enclosed in the goal area for 60 sec. Testing continued until the lamb made 10 consecutive runs to the goal area where the cohabitant was tethered.

A second series of learning trials was conducted on day 72 (± 2). In this, the contrast series, a ewe was placed in one goal area, and a

canine in the other. One of these animals was the lamb's cohabitant. The position occupied by the cohabitant was opposite its placement in the previous series. The lambs were again given four forced runs, two to either side, prior to the first test trial. Two additional forced runs were interspersed between trials 10 and 11. Twenty consecutive test trials were run.

The final series of tests was conducted after 105 ($\pm$ 2) days of confinement. Each lamb was observed over a series of trials where the cohabitant was removed from the compartment, then reintroduced. The removal-replacement alternation sequence was continued until 11 observations of 60 sec. duration had been obtained for each lamb. The measure of behavioral disturbance recorded was the frequency of vocalizations, i.e., number of bleats per minute emitted by the lamb.

The U-maze was of plywood and wire construction. Thirty-in wide runways were enclosed by 4 ft plywood walls, and covered by translucent netting material. The dimensions of the runway segments were: start compartment to choice point, 12 ft; choice point to turn, 7 ft; turn to goal area, 4 ft. The goal areas were 8 ft × 8 ft. Guillotine doors were located in the start compartment, and on either side of the choice point.

RESULTS

Non-contrast learning trials: All the animals learned rapidly, committing few errors prior to reaching criterion. A comparison of the error scores indicated no difference between the lambs assigned to the ewes and those assigned to the canines. Indeed, the lambs in the interspecies condition made somewhat fewer (nonsignificantly) errors than those paired with the ewes: mean errors, 3.0 and 4.8, respectively. The lamb's behavior upon reaching the empty goal compartment on "error" trials is of some interest: the animals bleated, repeatedly and vigorously, and paced in an agitated fashion. These behaviors were rarely observed when the lamb entered the goal area of its cohabitant (mean bleats in goal compartment: empty = 16.08; cohabitant = .99). Typically the lamb approached and remained close to his cohabitant.

Contrast learning trials: Figure 7-27 summarizes these results. Clearly the lambs acquired responses which were instrumental to reaching the animal with which they had been housed, regardless of its species. The distributions of choices of the two groups of lambs were non-overlapping ($t = 7.83$; $df = 6$; $p < .001$).

Removal-replacement of cohabitant: The lamb's repeated bleating formed one significant part of the general pattern of behavior disorganization that could be observed when the cohabitant was removed from the living compartment. Correlated behaviors included agitated pacing, jumping against the walls, and pushing the compartment door. A perfect contingency

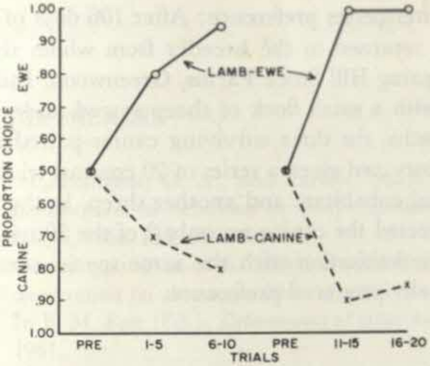

Figure 7-27. U-maze performance of canine-paired and ewe-paired lambs in the contrast series.

was obtained between vocalization and the absence of the cohabitant (bleats/min. present = 0.00; bleats/min. absent = 17.3). The difference between pairing conditions was not significant (see Fig. 7-28).

Following response: One of the most striking response patterns observed was the development of a strong following response by the lambs. Scott (1945) has noted that orphaned lambs developed such a response to their human caretakers. In the present experiment, however, every lamb exhibited a marked following response with respect to its cohabitant by the 9th week of pairing.

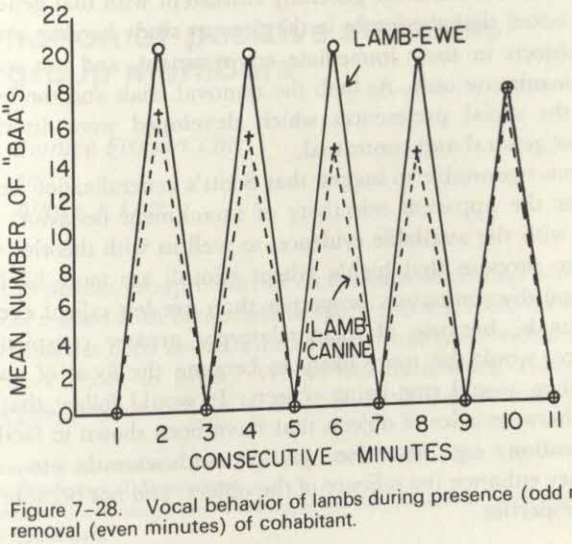

Figure 7-28. Vocal behavior of lambs during presence (odd minutes) or removal (even minutes) of cohabitant.

Reversibility of interspecies preference: After 106 days of confinement, all of the lambs were returned to the breeder from whom they had been originally acquired (Spring Hill Stock Farms, Greenwood, Indiana). These animals were placed with a small flock of sheep reared under normal conditions. After four months, the three surviving canine-paired animals were returned to the laboratory and given a series of 20 contrast trials. The choice objects were the original cohabitant and another sheep. In the final block of 10 trials, the lambs selected the canine on only 2 of the 30 trials (7%). Apparently an extended cohabitation with the same species was sufficient to reverse the experimentally produced preference.

DISCUSSION

Recent investigators (Denenberg et al, 1964; Hersher, Richmond, & Moore, 1963) have reported the formation of interspecies attachments, e.g., mouse-rat, sheep-goat, following the animals' participation in cross-species fostering experiences. The present data extend these findings in demonstrating that remarkably strong interspecies attachments can be produced even when the animals have not been involved in extensive physical interaction. These data, it should be noted, suggest limitations on the generality of recent theoretical accounts of mammalian attachment behavior (Harlow & Zimmerman, 1959; Gerwirtz, 1961).

Scott (1962) has proposed the empirical generalization that a mammal will develop an attachment toward any object to which it is continuously exposed. While our data are generally consistent with that generalization, it should be noted that the lambs in the present study became attached to the animate objects in their immediate environment, and not to the equally available inanimate ones. As both the removal trials and the learning series indicate, the social preferences which developed were discriminant and specific, not general and contextual.

It seems reasonable to suggest that Scott's generalization be amended to account for the apparent selectivity of attachment behavior. It would be consistent with the available evidence, as well as with theories of associative learning, to propose that highly salient stimuli are more likely to acquire elicitory and discriminatory properties than are less salient events. Accordingly, animals, because of their relatively greater conspicuousness and prominence, would be more likely to become the focus of an attachment response than would non-living objects. It would follow that the various stimulus characteristics of objects that have been shown to facilitate attachment formation, e.g., lactation, softness and warmth, etc., are effective because they enhance the salience of the object, and not because of presumed hedonic properties.

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The formation of positive attitudes toward group members

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In an attempt to predict group behavior on the basis of general psychological principles as contrasted with formulations specific to the area, the concept of group cohesiveness has been re-examined and reformulated within a learning theory framework (Lott, in press). Within this framework, cohesiveness is defined as *that group property which is inferred from the number and strength of mutual*

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A paper, based on this investigation, was read at the 1959 American Psychological Association meetings in Cincinnati.

positive attitudes among the members of a group. The concept of attitude is used, instead of the more usual one of attraction, because of its precise and particular meaning within learning theory, i.e., an implicit anticipatory response having cue and drive properties (Doob, 1947). By defining cohesiveness in terms of mutual positive attitudes among group members, the assumption is made that the members who comprise a group constitute its most significant components.

A number of hypotheses regarding both the antecedents and consequents of cohesiveness, as defined above, have been derived from learning theory (Lott, in press). The problem of this experiment has been to test the most fundamental of these hypotheses, one which concerns the conditions under which positive attitudes toward group members may be formed.

It is predicted that if a person is rewarded in the presence of others (fellow group members), he will develop positive attitudes toward them. This proposition rests upon the following assumptions:

1. Persons may be conceptualized as discriminable stimuli to which responses may be learned.
2. A person who experiences reinforcement or reward for some behavior will react to the reward, i.e., will perform some observable or covert goal response (R_g or r_g).
3. This response to reward will become conditioned, like any other response, to all discriminable stimuli present at the time of reinforcement.
4. A person (group member) who is present at the time that Individual X, for example, is rewarded thus becomes able, in a later situation, to evoke R_g or, what is more likely, its fractional and anticipatory component $r_g - s_g$. This latter response, which Hull has called "expectative" (1952, Ch. 5), was earlier interpreted by Doob (1947) as the underlying mechanism of an attitude.

The specific prediction tested by this study is that members of three-person groups who are rewarded for their performance in the presence of their fellow group members will more likely develop positive attitudes toward them than will members of such groups who are not rewarded. Positive attitudes are inferred, here, from choices made on a sociometric test subsequent to, and outside of, the experimental situation.

Method

Subjects. Forty-eight children from the University of Kentucky Elementary School, 24 each from Grades 3 and 5, served as *S*s.[1]

[1] The authors wish to acknowledge the cooperation of the following persons whose kind assistance made possible both the reported experiment and the pilot work which preceded it: M. Hitch, Principal of Rosenwald Laboratory School, Frankfort, Kentucky; A. Wolfe, intermediate grade teacher at Rosenwald; E. Sasman, Principal of University Elementary School, Lexington, Kentucky; A. Boone, M. Moore, and O. Barrett, teachers at University School of the third, fourth, and fifth grades, respectively.

Procedure. The *S*s were divided into 16 three-member groups, following the administration of two sociometric tests. These tests were given, by the regular classroom teachers, on two consecutive days, several days before the actual experimental situation. On the basis of the test results the groups were formed so that each group was made up of children who had *not chosen each other* on either of the tests. Four all male and four all female groups were formed from Grade 5.

Omitting the preliminary instructions, the criterion question asked in the first test was as follows:

> *Test I.* Let us suppose that each one of you gets picked to take a trip to the moon in a rocket ship. This is a very special trip. . . . It is important for everyone who is on the same ship to get along well with each other. . . . Because of this you get a chance to pick two children to go along with you. Now, of all the children in this class, which two would you pick to travel in the same rocket ship with you?
>
> *Test II.* [For this test the children were asked to think of themselves as visitors from Mars and to choose two classmates whom they would like to have waiting for them when their spaceship landed on Earth.]

For a group situation in which rewards and nonrewards could be manipulated, a board game called "Rocket Ship" was devised. The object of the game, played by groups of three, is to land cardboard rocket ships on planetary objectives. Each objective is reached by traversing a separate path containing four danger zones, at each of which a choice between a white and a striped subpath (one "safe" and the other "dangerous") must be made. By having the children in a group take turns crossing the danger zones first, the *E*s could arrange to have some children succeed and others fail in reaching the planets safely. The manner in which this was accomplished will be described below.

On the day of the experiment proper (separate days for the two classes), the *E*s were introduced to *S*s as having developed a children's game which they wished to test. One group at a time was called upon (in a predetermined random order) to play the game in a room adjoining the regular classroom.[2] The following instructions, given to each group by one of the investigators (E_1), describe the manner of playing:

> . . . You three are rocket ship pilots. Each one of you has your own ship but you are going to take a trip into outer space together, side by side. The first trip you are going to take is to ——. In order to get there you

[2] Wherever a child, preselected for a particular group, was absent on the day of the experiment, a substitute who met the criterion of nonchoice by, and of, the other group members, was, in all cases, available.

> must follow this path which scientists have decided is the safest way to go. The scientists also know that, at a few points along the way on this path, there is great danger. When you get to one of these dangerous points you are going to have to stop and decide whether the striped path or the white path is the dangerous one. One of the paths will get you past the danger safely. If you take the wrong path your rocket ship will be blown up and you'll have to parachute to Earth. . . . When you get to a danger point you'll have to decide which one of the group will take a chance and be the first to try either the striped or white path. If he gets through safely, the other two rockets may follow him. If his ship should get blown up, though, the other two ships will take the other path which you will know to be safe. You'll know that a ship has been blown up when you hear the sound of a bell, like this [sounded by E_2]. . . . Remember, you must take turns being first.
>
> . . . It's possible for all three of you to get through to a planet safely, but it may be that only two of you will make it, and maybe just one or none of you will make it. . . . . If you reach a planet safely you will be able to choose one of these prizes [small plastic auto models] which you may keep. . . . We'll play half the game this morning and half this afternoon.

Each group tried for three objectives in the morning and three in the afternoon. Half the total number of *S*s was permitted to land safely on four planets (two at each session) while half was prevented from reaching any of them. "Reward" was thus defined as the receipt of four plastic car models (one for each successful landing). A child was either "rewarded" or "not-rewarded," i.e., made no successful landings at all and received no prizes; there were no in-between conditions. Prizes won in the morning session were held by the *E*s until the end of the afternoon session at which time the rewarded *S*s returned to their classroom with four model cars and the nonrewarded *S*s returned with none.

Rewarded and nonrewarded *S*s were selected on a random basis prior to the game. A nonrewarded *S* always had his ship "blown up" when, at his chance to go first at a danger point, he took either the striped or white path.[3] As soon as he made his choice of path, the "blow up" bell was rung by E_2 who sat somewhat apart from the game area.

Each group had been randomly assigned, prior to the game situation, to one of the following conditions which describe the number of group members who were to be rewarded during the game: zero, one, two, all. Four groups, two from each class, were assigned to each condition. This aspect of the design was introduced to avoid having the *S*s suspect that the game was

[3] Each child was in the position of "being first" at a danger point at least once on his way to each of the planets since *S*s had been instructed to take turns and there were four danger zones per path and three children in a group. It was always possible, therefore, to "blow up" non-rewarded *S*s without interfering with a group's spontaneous behavior regarding which child would go first at which point.

"rigged." The natural flavor of the game was maintained by having *Ss* know that it was possible for all three group members to be successful, or only two, etc.

Shortly before the close of the school day, approximately one hour after the last group had played the game, the classroom teacher administered another sociometric test (III), as follows:

> Suppose your family suddenly got the chance to spend your next vacation on a nearby star out in space . . . you can invite two children to go on the trip . . . and spend the holiday with you on the star. Which two children in this class would you choose to take with you?

After the choices were collected by the teacher, E_2 appeared before the class to thank the *Ss* for their cooperation and help. And, because everyone had been such "good sports," four prizes were distributed to each of the youngsters who had not won them during the game.

Results

The results of the final sociometric test (III), which succeeded the play-group experience, are presented in Table 7-1. The proportion of play-group members chosen by rewarded *Ss* was found to be significantly greater than the proportion chosen by nonrewarded *Ss*. The obtained critical ratio, corrected for continuity, is 2.14 ($p = .03$; two-tailed). This confirms the prediction that *Ss* who had been rewarded would choose members of their groups, on the final sociometric test, significantly more often than *Ss* who had not been rewarded.

Table 7-1. Choices made by subjects on sociometric test III

Subjects	Choices		N*
	Play-group member	Non-play-group member	
Rewarded	11	37	48
Nonrewarded	3	45	48

* N=number of choices made; each S made two choices.

DISCUSSION

The present findings indicate that the formation of positive attitudes toward persons is predictable from learning theory principles and can be studied in the laboratory. This study thus extends the applicability of a general S-R framework to significant social behavior.

The prediction that positive attitudes toward persons can be formed by experiencing reward in their presence, was clearly confirmed. Since it is in

terms of such positive attitudes among the members of a group that cohesiveness has been defined, the present experiment is seen to be concerned with the antecedents or determinants of cohesiveness even though no attempt was made to measure the variable directly. The specific concern of this first study was with the development of positive attitudes toward group members and not with the group property that results from such attitudes when they are mutual.[4]

There have been comparatively few experimental attempts to vary group cohesiveness other than by suggesting to the members of a group that they will like each other. One investigation in which determinants were experimentally manipulated (Thibaut, 1950) found a positive relationship between cohesiveness and group status. In another study, more relevant to the present one (Bovard, 1951), a significantly greater level of interpersonal affect was found in group-centered as compared with traditional leader-centered classes. Bovard suggested that this result was due to the fostering, in group-centered classes, of member-to-member interaction which produces greater accuracy in inter-member perception, creating, according to Bovard, a situation conductive to "need satisfaction." That the experience of need satisfaction (reward) in the presence of group members can, indeed, result in positive affect toward those group members has been demonstrated in the present experiment.

The results obtained in this study should be evaluated in the light of the following factors which could only have tended to work against substantiation of the hypothesis:

1. Play-group members were, by design, neutral or negative stimuli for one another at the beginning of the experimental situation. This was assured by placing, in a group, only *S*s who had not chosen one another on two previous sociometric tests.

2. The amount of reward experience received by rewarded *S*s in the presence of others was extremely small when compared with the amount of daily contact our *S*s typically had with each other in the classroom, playground, and after school. (Practically all the *S*s in each of the classes had been together for their entire schooling, beginning with kindergarten.)

3. The choices made on the two preexperimental sociometric tests (I and II) were found to be unexpectedly stable for third and fifth graders, indicating relatively reliable friendship ties[5] which the experimental experience was able to disrupt, however temporarily.[6]

[4]An operational measure of cohesiveness which follows directly from the definition of the concept given earlier has been developed by the investigators and will be reported in connection with its use in another study.

[5]Forty percent of the *S*s made the same two choices on both tests; another 42 percent of the *S*s repeated one choice on both tests.

[6]No follow-up test was given since there was no reason to expect that the positive attitudes formed during the brief game situation would last, in the absence of continued reward experience in the presence of the same individuals.

Despite the above factors the prediction, that positive attitudes toward persons will be developed as a result of the receipt of reward in their presence, was clearly supported. Though the results were obtained with children, there is no reason to expect that they would not hold with adults as well. Such generalization must, of course, await adequate test.

The variable manipulated in the present study was simply reward vs. nonreward. Future research might profitably deal with variations in reward frequency, delay, and schedule, for example, as these affect the conditioning of attitudinal responses, and, consequently, as these affect the development of cohesiveness in small groups. That the results obtained in this study were predicted from general behavior principles increases our confidence in the promise which this kind of an approach holds for the general area of small group behavior.

SUMMARY

Three-member groups of children played a game in which some members were rewarded and others were not. On a later sociometric test, outside of the game situation, rewarded *S*s chose a significantly greater proportion of their fellow group members than did the nonrewarded *S*s. These results were predicted from general principles of S-R learning theory.

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8

SEXUAL BEHAVIOR

Sexual behavior is an important part of the social and especially of the affectional behavior of most animals. Although much has been written on the psychology of human sexual behavior, little direct study has been possible because of social taboos. However, the sexual behavior of nonhuman animals has been extensively studied by ethologists (Armstrong, 1965; Bastock, 1967; Eibl-Eibesfeldt, 1970). The most striking aspect of nonhuman sexual behavior is the stereotyped courting display that precedes copulation in many species. Courting displays are regarded by ethologists as instinctive; the animal is expected to perform them almost regardless of its behavioral history. Indeed, human sexual behavior is probably the human social behavior most interdependent with physiological factors. Although the experimental study of sexual behavior is still far from adequate, several approaches to the subject are possible.

One approach attempts to identify the prior experiences essential to adequate reproductive functioning. In some animals, the necessary social experience appears to be minimal; for example, Beach (1958) found that rats isolated at 14 days of age later showed normal sexual behavior. The locomotor responses of 14-day-old rats are limited, and precopulatory behavior, such as mounting, does not normally occur until after 21 days of age. Nevertheless the isolated rats were able to emit the comparatively complex sequence of behavior necessary for copulation. However, early experience does have an effect on sexual functioning. Valenstein, Riss, and Young (1955) found that guinea pigs isolated at 10 days of age showed greater deficiencies in their sexual behavior than did guinea pigs isolated at 25 days of age. Valenstein and Young (1955) reported that, although the administration of testosterone increased the sexual behavior of some castrated guinea pigs, testosterone did not affect the very low level of sexual behavior exhibited by castrated guinea pigs that had been isolated at 25 days of age. Apparently, the castrated, isolated animals had not developed the behavior necessary for response to the testosterone. Rhesus monkeys raised by Harlow in various degrees of isolation, both with and without surrogate mothers, did not develop normal sexual responses as

adults. However, when Harlow and Harlow (1962) allowed monkeys raised with surrogate mothers to interact with other juvenile monkeys, normal sexual behavior did develop. A paper reporting the latter results appears in Chapter 9 of this volume.

The first paper included in the present chapter, by G. W. Meier and entitled, "Other data on the effects of social isolation during rearing upon adult reproductive behavior in the rhesus monkey (*macaca-mulatta*)" studies the effect of isolation during early life on adult sexual behavior of rhesus monkeys. Meier isolated monkeys one day after birth and housed them in cages from which they could see, hear, smell, but not touch other monkeys. In spite of the limitations on their social experience, the later sexual behavior of these monkeys was indistinguishable from that of monkeys raised in the wild. Apparently tactual social interactions early in life, although possibly of great importance in the development of some affectional behavior (Harlow, 1958), are not necessary for the development of sexual behavior in rhesus monkeys. Meier's description of the rearing conditions used in the experiment points up the variety of factors encompassed by terms such as "isolation" and "restriction." Because of the many variables involved, it is often difficult to compare the conditions under which animals in various studies were "isolated." Small differences in procedure could account for differences between, for example, the results of Harlow and Harlow and of Meier. On one hand, extreme forms of isolation do seem to produce abnormal sexual behavior. On the other hand, only minimal social contact seems to result in normal sexual behavior in nonhuman animals. Studies in which early social interactions are actually controlled in detail could give a clearer picture of exactly what early social experiences are essential for the development of adequate sexual behavior.

Another approach to sexual behavior analyzes the nature of the response by using conditioning procedures to modify the relationship of the response to the environment. This approach is taken in the second study included in this chapter. The paper is by H. E. Farris and is entitled, "Classical conditioning of courting behavior in the Japanese quail, *coturnix coturnix Japonica*." The courting behavior studied is typical of the sequence of responses that reliably precedes coitus in many species. The behavior is usually said to be "released" by an environmental stimulus. The sequence is generally regarded as instinctive. However, simply dubbing behavior "instinctive" does not explain it. The relationship of complex, stereotyped behavioral sequences to physiological and to environmental stimuli is not completely understood. Lehrman (1961) has suggested that reproductive sequences are chains of responses that begin with a physiological state. Each behavior in the chain provides the physiological and environmental factors that produce the next link in the chain. Without such sequential experience, physiological factors

such as hormone levels are ineffective in producing later behaviors in the chain.

In the paper presented here, Farris shows that the entire courting sequence can be conditioned by employing the methods used in the classical, respondent conditioning of simple behaviors such as salivation and pupillary dilation. The so-called unconditioned stimulus, in this case a female Japanese quail, was paired with a previously ineffective, or neutral stimulus, in this case a buzzer. Eventually, the behavior previously produced by the female quail was produced by the buzzer as well (further discussion of respondent behavior and conditioning appears in Chapter 6). Farris checked for two phenomena associated with respondent conditioning: spontaneous recovery and pseudoconditioning. The effectiveness of respondent conditioning is tested during extinction, when only the formerly ineffective, conditioned stimulus is presented. After a pause in the extinction procedure, such as occurs between experimental sessions, the rate of response to the conditioned stimulus is sometimes higher than it had been just before the pause; this phenomenon is known as spontaneous recovery. The fact that Farris' conditioning of the courting behavior included this effect indicates further that the procedure did produce a true case of respondent conditioning.

Pseudoconditioning is a phenomenon associated with respondent conditioning that the experimenter hopes to avoid. Repeated presentations of some neutral stimuli may elicit some responses without any close temporal pairing with an unconditioned stimulus. High-intensity stimuli such as loud noises are particularly likely to produce this pseudoconditioning effect. Farris used a standard procedure to check for pseudoconditioning. Using control animals that had not been subjected to the conditioning procedure, he presented both the buzzer and the female quail, but without the close temporal pairing used in the conditioning procedure. The fact that the buzzer did not elicit the courting display after repeated, unpaired presentations of the buzzer and the quail indicates that Farris produced true respondent conditioning of the behavior.

Although the courting behavior of the Japanese quail can be conditioned in the same manner as respondent behavior, all sexual behavior is not necessarily reflexive in the same sense that simple responses such as pupillary dilation or salivation are reflexive. Many complex responses can have various, coexisting relationships with environmental stimuli. As noted in Chapter 6, aggression can be conditioned as a respondent. However, the aggressive response to pain was also shown to be in itself reinforcing, since animals would emit an operant response to obtain an attackable object. Also, aggressive behavior can be conditioned in the same manner as operant behavior. Nevertheless, Farris' work shows that even complex sexual behavior can sometimes be characterized

as respondent behavior since its relationship to the environment can be modified through respondent conditioning.

Various approaches to the study of human sexual behavior have been attempted. The study of human sexual behavior has been limited by public sanctions on explicit approaches to sexual behavior, and perhaps also by the feeling that sexual experience would be spoiled by being studied. Kinsey's work in the late 1940's and early 1950's, although simply a questionnaire and interview study of sexual behavior and attitudes, created a furor (Kinsey, *et al.*, 1948, 1953). The interpersonal aspects of sexual behavior have been exhaustively treated on a speculative level (e.g. Fromm, 1956). More recently, a direct, detailed descriptive study primarily of the physiological aspects of human sexual behavior has been reported by Masters and Johnson (1966). A method for measuring penile erection has been developed by Laws and Rubin (1969) and has been used to study erection in response to erotic films. Some control over sexual responses has been reported using aversive stimuli (Kushner, 1965; Raymond, 1960) and a procedure known as desensitization (Lazarus, 1965).

Probably the most valuable recent contribution to an understanding of human sexual behavior was made by Masters and Johnson (1970) in their treatment of various sexual dysfunctions. Although treatment of sexual deficits and disorders does not include the careful experimental controls taken for granted in the study of some behaviors, it does ultimately require an understanding of the factors that control sexual response. Masters and Johnson's treatment of premature ejaculation, in particular, is based on a sound analysis of sexual behavior and interaction. Their technique is adapted from one developed by James H. Semans (1956). Since neither Semans' nor Masters and Johnson's work was available for inclusion in this volume, a detailed account of their approach is given here.

Semans treated the problem of premature ejaculation by first specifying the behavior ultimately desired—vaginal stimulation of the penis for a period of time without ejaculation. Then behavior approximating the desired behavior was prescribed for the patients. First the penis was to be stimulated manually by the wife, the stimulation ceasing when sensations premonitory to ejaculation were felt. After such stimulation could be tolerated for adequate periods of time, lubrication of the penis was added to more closely approximate the conditions attendant upon vaginal containment. After tolerance of stimulation with lubrication was developed, actual vaginal containment was attempted. Semans' technique also involved stimulation of the wife, preferably terminating in orgasm. Thus the technique promoted mutual reinforcement between partners, concurrent with shaping the sexual response desired from the husband.

For all sexual disorders, Masters and Johnson prescribed an initial "sensate-focus phase" in which one partner stimulated the other, at first deliberately avoiding genital areas, and later including them. The next step in the treatment of premature ejaculation also involved extra-vaginal stimulation of the penis. When sensations premonitory to ejaculation were felt, the clients were instructed to employ a "squeeze technique" in which pressure is applied on the dorsal and ventral sides of the coronal ridge of the penis. The pressure eliminates the urge to ejaculate and probably offers better control than the cessation of stimulation prescribed by Semans. From manual stimulation, Masters and Johnson's technique moved on to vaginal containment in the female-superior coital position. The position facilitates removal of the penis from the vagina when the sensations premonitory to ejaculation are felt. As did Semans, Masters and Johnson emphasized the importance of the participation of the wife in the learning of ejaculatory control. The control must, in effect, be learned under the conditions of social interaction that actually occur in the course of sexual relations. Masters and Johnson's technique for treating premature ejaculation was successful in nearly 99 percent of the cases treated.

Masters and Johnson, in their chapter on the treatment of premature ejaculation, give a convincing account of the etiology of the behavior. Premature ejaculators typically have a history in which rapid ejaculation has been reinforced. The history may have involved contact with prostitutes whose only interest was in disposing of the client as soon as possible. Alternatively, a history of rapid ejaculation with emphasis only on satisfaction of the male may have occurred in the situations encountered, for example, by teenagers whose sexual encounters take place in settings with little or transient privacy. Use of the withdrawal technique of contraception is often found in the history of premature ejaculators. Semans' work suggests that, in the sexual technique of many premature ejaculators, pre-coital sexual stimulation of either partner is minimal. In short, the history of premature ejaculators involves sexual encounters that emphasize the man's sexual satisfaction, usually to be accomplished as rapidly as possible.

Masters and Johnson report that clients generally do not seek help in changing patterns of premature ejaculation until after five to twenty years of marriage. By that time, the social interaction between partners has usually exacerbated the problem. The wife's reaction to the problem has progressed from tolerance and understanding to resentment and accusation. Home-grown attempts to prolong intercourse without ejaculation have usually involved avoiding any stimulation of the penis except intravaginally. This technique only makes the man less able to tolerate stimulation. The wife's negative reactions may have lead to a decrease in frequency of sexual intercourse, which only makes ejaculation more uncontrollable. Sometimes discord has led to episodes of

impotence. Thus the sexual problem, when finally encountered by the therapist, is often the product of years of malfunctioning socio-sexual interaction.

Indeed throughout Masters and Johnson's book, the effects of learning and social interaction on sexual behavior are striking. Sexual deficits such as impotence and frigidity do not seem to correlate with traditional psychiatric factors such as a domineering mother and a weak father. Rather, they often result from personal histories in which sexual behavior and expression are consistently punished. Alternatively, a single, extremely punishing or traumatic experience may cause a deficit in some individuals. As Masters and Johnson point out, many individuals undergo such punishing experiences without subsequent deficits. Other historical, concurrent, or subsequent experiences may be responsible. However, learning does appear to have an extremely important role. In terms of social interaction, a malfunction in the behavior of one partner is often the result of and/or creates a malfunction in the behavior of the other partner. Conversely, effective sexual function depends on a viable interaction between the behaviors of both individuals. In other words, human sexual behavior must be understood, at least in part, in terms of social behavior.

Recently, "sex education" has become a popular topic of discussion. Unfortunately, beyond the physiological details, little is objectively known about the development of human sexual behavior. Environmental and interpersonal factors are as important to human sexual behavior as are physiological factors. An objective knowledge of the psychology of sexual behavior would be a valuable addition to knowledge of human social behavior, contribute to the development of satisfying sexual adjustments, and provide a basis for the control of abusive or personally distressing sexual behavior.

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Other data on the effects of social isolation during rearing upon adult reproductive behaviour in the rhesus monkey *(Macaca-Mulatta)*

Gilbert W. Meier

The devastating effects of infantile social isolation upon the adult reproductive behaviours of the rhesus monkey have been described repeatedly by investigators in the Wisconsin Primate Laboratory (Harlow & Harlow, 1962a, 1962b; Mason, 1960). Animals which had been reared in relative social isolation, sometimes with mother surrogates, showed marked inability to breed; if conception was achieved, they failed to demonstrate fully appropriate or adequate rearing behaviours. These deficiencies have been emphasised as confirmatory of the critical period hypothesis (Scott, 1962) or as indicative of infantile and juvenile learning for adult sexuality (Patton & Gardner, 1963). By contrast this report presents descriptions of essentially normal reproductive behaviours in monkeys reared under conditions of deprivation of the tactual stimulation naturally afforded by the mother, sibling, or peer; or experimentally, by a cloth-wire mother surrogate.

METHOD

Subjects

The subjects were 14 rhesus monkeys (*Macaca mulatta*) which had been reared in the nursery and colony of the Laboratory of Perinatal Physiology. For the purpose of other studies, of these 4 males and 10 females, 6 were asphyxiated at birth; 8 were the treatment controls. Nine were delivered surgically at 156 to 160 days of gestation; 5 were delivered vaginally at about 145 to 160 days of gestation and were separated from their mothers on the morning following

From *Animal Behavior*, 1965, **13**, 228-231.

birth. The procedures by which these groups were formed are described in earlier reports from this laboratory (Ranck & Windle, 1959).

As infants, the animals were reared in social isolation from other monkeys, on a terrycloth surface, in a metal cage measuring 22 inches × 18 inches × 15 inches. Under these conditions they were able to maintain themselves on a self-demand regimen and suck at the bottle mounted at the rear of the cage.[1] Until 60 days of age, the animals were checked daily for weight, temperature, and other physiological signs. Thereafter, all were housed individually in larger cages, 25 inches × 27 inches × 32 inches high and weighed weekly (Fleischman, 1963). Four (Nos. 62, 63, 69, and 70) were examined repeatedly between birth and 60 days of age for aspects of behavioural development; between 60 and about 450 days of age, they were tested on a battery of behavioural tasks (Saxon, 1961a, 1961b; Saxon & Ponce, 1961).

When conditions of physical health and menstrual regularity permitted, the females were entered into the laboratory breeding programme. Each female was placed with an experienced male on Days 10 through 12 after the onset of last menstruation. After removal, a vaginal lavage was made. Ten days after the succeeding bleeding period and prior to the next mating, the female was palpated for signs of possible conception from the previous mating. If no signs were present, she was placed once again with an experienced male. This procedure was repeated until conception occurred. Observations were made routinely of the course of pregnancy and, in detail, of the birth and initial reactions to the newly-born infant. In the case of 3 of the deliveries, the infants (of Nos. 45, 69, and 70) were permitted to remain with their mothers for the first 3 postnatal months. The behaviours of the mother and infant were repeatedly observed and, on occasion, photographed.

The males were introduced into the breeding programme when about 4 years of age. Following the 48-hour mating period with an experienced female, the success of the male's endeavours was determined by the presence of sperm in the vaginal tract and the diagnosis of pregnancy in the female.

RESULTS

The personal history and conception data of the ten females observed in this study are presented in Table 8-1. All 10, unselected from the group of laboratory-reared monkeys in this colony, conceived during the fourth or early in the fifth year of life. The pregnancies of females Nos. 56, 63, 128, 150, and 152, however, terminated in abortion or in caesarean delivery for experiments other than the one here. These eventualities precluded, of course, observations on maternal behaviours.

[1] One female, No. 7, was born in the Carnegie Institute of Washington in Baltimore, Maryland. She was reared with her mother until one month of age at which time she was separated and maintained thereafter in isolation, as were the others of this study.

Table 8-1.

Female	Birth date	Delivery	G.A.	Matings	Sperm Test	Offspring
7	7-7-60	v/d; cont	160	8	6	5-5-64; v/d
45	7-7-58	c/s; asph	160	4	1	7-31-62; v/d
69	1-26-59	c/s; asph	157	2	1	8-27-62; v/d
70	1-27-59	c/s; cont	157	13	4	9-25-63; v/d
119	11-24-59	v/d; cont	145	4	2	1-19-64; v/d
56	10-15-58	c/s; asph	157	9	6	10-30-62; c/s
63	11-21-58	c/s; asph	157	11	6	7-7-64; c/s
128	1-7-60	c/s; asph	156	7	1	7-8-64; c/s
150	5-9-60	c/s; asph	156	3	1	10-26-63; c/s
152	5-10-60	c/s; cont	158	7	6	4-8-64; aborted

Note: asph—asphyxiated. cont—control. c/s—caesarean section. G.A.—gestional age. v/d—vaginal delivery.

Table 8-2, which presents the breeding picture of the males of this study, reveals that all males were capable of adequate insemination and, in 3 cases, of fertilisation. This compilation does not indicate the earliest possible age of insemination (a limitation of the breeding situation: the males were used at the convenience of the breeding programme of the colony as a whole) nor does it indicate the success of the initial contacts or the behaviours elicited at the time. Since comparative data on feral-reared, virginal animals are not available in the context of this breeding situation, the inclusion of data on the initial encounters is not deemed relevant. In any case, the ratio of the number of positive sperm tests to the number of matings as well as that of the number of conceptions to the number of matings are well within the ranges recorded in this laboratory for feral-reared males with the same group of unselected females. Information on sperm count and motility is not available for either group of males. In general, the breeding records of these laboratory-reared animals, males and females alike, do not differ from those animals introduced into the breeding programme after development in a feral state and after, in some cases, known breeding experience (Ponce de Lugo, 1964).

The normality of the male breeding behaviour is depicted in Figure 8-1. The hindlimb-clasping of this male, No. 53, is the posture deemed typical and necessary in the study by Mason (1960).

Similarly, the normality of the maternal behaviour is depicted in Figure 8-2. This representative pose is a sharp contrast to that illustrated in Harlow & Harlow (1962a).

Table 8-2.

Male	Birth date	Delivery	G.A.	Matings	Sperm tests	No. of offspring
43	7-01-58	v/d; cont	156	4	1	1
49	8-13-58	v/d; cont	161	17	5	1
53	9-20-58	v/d; cont	160	42	21	1
62	11-19-58	c/s; cont	156	10	2	0

Figure 8–1. Laboratory-reared male, No. 53, mating with experienced female.

The pregnancies listed in Table 8-1 were fully normal in course and accompanied by what are believed to be fully normal maternal behaviours. In every case, the female displayed immediate concern over the infant after its initial appearance. She would clasp it, lick it, pull at it, and in other ways maximise contact with it. Usually this indulgence was interrupted by the appearance of the placenta with which she was occupied until its total or near-total consumption. After this interlude, lasting an hour or more, the female returned to the infant; she grasped it and usually clutched it to herself. Within the first 12 hours after parturition, the now-dry and somewhat cleaned infant made contact with the mother's nipples and began to suck.

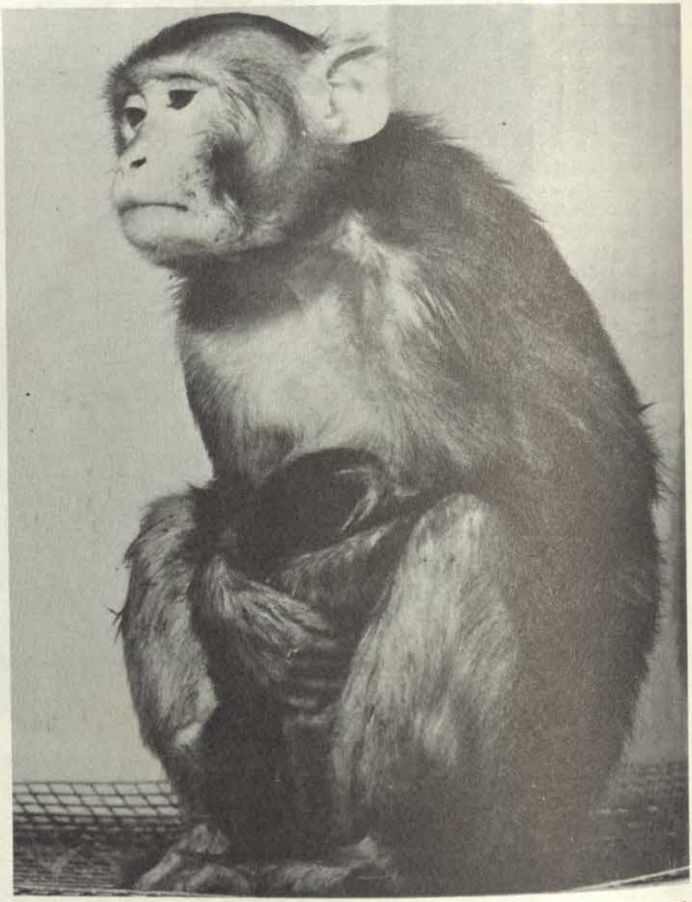

Figure 8–2. Laboratory-reared female, No. 70, with her infant about 12 hours after its birth.

Those females permitted to keep their infants during the succeeding 3 months behaved very much like the feral-reared mothers. They were protective of the infant, attentive to its condition and whereabouts, possessive when intruded upon, and, when feasible, aggressive toward the intruder. Only in the intensity of their behaviours on the last two dimensions did these females differ from the others observed. Nevertheless, by contrast with their pre-partum behaviours, these females demonstrated a marked transition in their adversive attitude toward human handling which became greatly intensified although centered almost entirely upon the proximity of the offspring. If the infant was removed, as was occasionally necessitated by interest in its health and development, these mothers reverted to their pre-partum tractability.

DISCUSSION

The differences in the behaviours described here and those described by Harlow and his collaborators are striking, but not readily understood. The origin of the procedures developed by the two laboratories (ours in San Juan and Harlow's in Madison) is the same (van Wagenen, 1950). At the founding of our nursery, significant interchange between the two laboratories existed on the necessary and sufficient conditions for optimal infant maintenance.

There are however, certain differences between the two laboratories in rearing techniques (Fleischman, 1963; Blomquist & Harlow, 1961) which could contribute to the later behavioural differences reported above. Our infants are hand fed only for their first 10 days of life, by which time they almost invariably have learned to feed for themselves and continue to do so, from rubber nipples, until weaned to solids at 60 days. Harlow's infants are usually hand fed until they are 15 to 30 days old, at which time they are weaned to a cup and subsequently, at 46 days, to solids. There are also differences in cage sizes. The cages in which our infants are reared and later maintained in San Juan, are somewhat smaller than those used in Wisconsin. However, the lesser handling by way of infant feeding and smaller areas of confinement might be expected to lead to more gross behavioural abnormalities in our adult monkeys, in comparison with Harlow's; rather than the reverse which we observe. All of the females are considerably more tractable than the usual, wild-reared females which constitute our colony. They permit themselves to be touched and superficially palpated when pregnant without aggression to the handler. The tractability appears in spite of the fact that no attempt is ever made to tame these animals; their only handling is that given by way of infantile care.

Furthermore, there are the differences in the spacing and arrangement of the individual cages which could influence the relative amounts of social interaction in the two colonies. In both our nursery and our juvenile-adult colony, the cages are in close proximity, much closer, apparently, than in the Wisconsin laboratory. In our nursery, the considerable amount of infantile vocalisation, from low "woo's" to high shrieks, is evident every day. More evident is the social contact, visual and auditory, in our juvenile colony. Threatening postures, self- and other-directed aggression are frequently displayed. Cursory visits to, and comments regarding the Wisconsin Laboratory suggest that this proximity and social interchange are never as great. If there are, in fact, such differences in visual and auditory proximity, the significance of tactual stimulation, peer contact and play, suggested by the Wisconsin investigators, has been greatly overemphasised. Hinde & Rowell (Hinde & Rowell, 1962; Rowell & Hinde, 1962) at Cambridge have described the visual and auditory communication in the rhesus monkey.

Perhaps the contribution of these forms of social interchange is vastly greater for normal development than has been previously supposed.

Finally, differences in the design of the experiments may have led to an exaggeration of the significance of the differences in the data collected in the two laboratories. Some improvement in reproductive performance with repeated testing has been reported by both Hansen (1962) and Mason (1960), in the males, and by Harlow & Harlow (1962b) in the female. In the first studies, the assessment of behaviour began at an earlier age than employed in the present study. In the last, successful reproduction with adequate maternal behaviour was attained in isolated examples but only after considerable maturation and experience. Which of these two variables, maturation or experience, is the more important can only be guessed at this time. Taking all studies together, one could infer a complicated interaction between rearing procedures, maturation, and adult experience.

SUMMARY

Data are reported on the reproductive behaviours of 14 rhesus monkeys which had been reared from infancy in relative social isolation. The 10 females were able to conceive; the 5 permitted to bear their young vaginally at term reacted to the offspring normally. The 4 males mated satisfactorily with species-typical positioning and, in 3 cases, sired offspring. The differences between these behaviours and those reported elsewhere are striking. The characteristics of the rearing conditions suggest the importance of visual and auditory contact in infancy and adolescence for the development of normal sexual behaviour.

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Classical conditioning of courting behavior in the Japanese quail, *Coturnix Coturnix Japonica*

Howard E. Farris

A number of animals exhibit complex unconditioned display reactions in the presence of certain stimuli. For example, many male animals display to the females of their species as part of the mating ritual and also display to other males before fighting. Braddock and Braddock (1955), Adler and Hogan (1963), and Thompson and Sturm (1965) report that a complex aggressive display is exhibited by the Siamese fighting fish, *Betta splendens*, in the presence of another *Betta*. The latter two studies have reported the classical conditioning of this unconditioned threat display using male *Bettas*.

Similarly, a complex courting display can be elicited from isolated male Japanese quail when a female quail is placed in its presence (Farris, 1964). The latency from the presentation of the female to the onset of the display is about 3 to 5 sec and the duration of the response pattern varies with the receptivity of the female. In most cases the display is terminated with copulation. After mating, there is a post-copulatory response which is similar to the original courting response and terminates the entire sexual ceremony. The present study was concerned with the display which occurs before copulation.

Identification and description of behavior

The courting pattern consists of at least the following five components: (a) *Increased neck and body tonus:* the posterior is elevated and the neck is thrust forward and slightly downward. From a side view the back is parallel with the floor and the male circles the female with head cocked inward toward the hen. The neck is slightly humped just behind the head. (b) *Leg action:* the legs straighten and stiffen with the body being brought up and forward. The body is swiveled at the hips so that the legs appear to be straight down. The leg is stiff during the strut. (c) *Toe walking:* the bird raises itself on its toes

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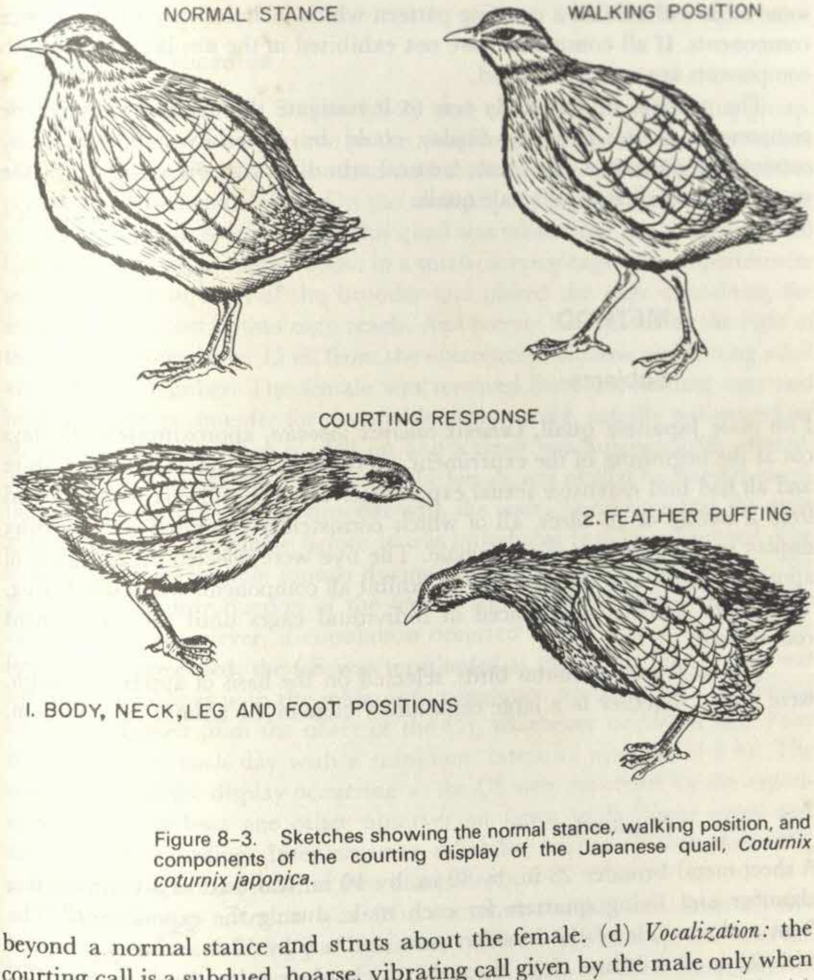

Figure 8–3. Sketches showing the normal stance, walking position, and components of the courting display of the Japanese quail, *Coturnix coturnix japonica*.

beyond a normal stance and struts about the female. (d) *Vocalization:* the courting call is a subdued, hoarse, vibrating call given by the male only when courting. It is a two-syllable squawk sound which lasts for several seconds. (e) *Feather puffing:* most of the body feathers from the neck downward are fluffed, accenting the breast, rump, and wing primaries. See Figure 8–3.

Sequence of components

For all birds, the components tend to appear in the above sequence, the main difference being the amount of time elapsing between the onset of the respective components. Usually the first three components are exhibited almost simultaneously, with the last two appearing from 1 to 5 sec later. However, in some cases all five components occur almost simultaneously. Most birds in the normal courting display exhibit all of the components. However, on occasion,

some birds will exhibit a courting pattern which includes only the first three components. If all components are not exhibited in the display, the last two components are usually omitted.

The purpose of this study was to investigate the extent to which the components of the courting display could be classically conditioned by consistently pairing a previously neutral stimulus with presentation of the unconditioned elicitor, a female quail.

METHOD

Subjects

Five male Japanese quail, *Coturnix coturnix japonica,* approximately 75 days old at the beginning of the experiment, were used. All were sexually mature and all had had extensive sexual experience. The five subjects were selected from a colony of 24 birds, all of which consistently exhibited the courting display in the presence of the female. The five were selected on the basis of apparent health and the tendency to exhibit all components when displaying. They were marked and placed in individual cages until the experiment commenced.

The six female stimulus birds, selected on the basis of apparent health, were placed together in a large community cage in the animal colony room.

Apparatus

A sheet-metal brooder 23 in. by 30 in. by 10 in. was used as a conditioning chamber and living quarters for each male during the experiment.[1] The front and one side of the brooder contained a 6 by 12 in. window covered with 0.5-in. hardware cloth through which observations were made. The front also contained a 4 by 6 in. Masonite swinging panel. The chamber was continuously lighted with one 60-w bulb. The floor of the chamber was 0.5-in. hardware cloth. Temperature was maintained at 75 degrees F and food and water were available at all times. The chamber was located on a table about 30 in. above the floor in a 15 by 12 ft darkened room. The lighting in this larger room remained off for the duration of the study.

The conditioned stimulus (CS) was a 6-v low-intensity buzzer attached to the top of the brooder; the unconditioned stimulus (US) was a female quail.

[1] The birds were raised in a similar brooder and habituated quickly to the experimental environment. An attempt to use another chamber specifically designed for the conditioning failed since the male subjects did not habituate readily to the new environment.

Procedure

Three of the males (S-1, S-2, and S-3) were used in the conditioning group. They were placed one at a time in the conditioning chamber two days before the experiment. This served both as an habituation period and a deprivation period from the female birds. On the morning of the third day, conditioning trials were begun. A female stimulus quail was taken from the living cage and brought to the experimental room in a small carrying cage. The experimenter seated himself in front of the brooder and placed the cage containing the female on the floor within easy reach. An observer was seated to the right of the experimenter about 15 in. from the observation window, permitting a full view of the chamber. The female was removed from the holding cage and held by the experimenter for a variable delay period, usually not exceeding 30 sec. The CS was then turned on and a timer was automatically started. Ten seconds after the onset of the CS the female was placed by hand through the swinging panel into the brooder with the male. At no time was the male able to observe the female before it was introduced into the chamber. The female made no audible sounds during handling. The CS remained on for 5 sec after the introduction of the female and was then terminated by the experimenter. However, if copulation occurred in less than 5 sec after the female was presented, the CS was terminated at that time. The female was left in the chamber with the male until copulation occurred or a maximum of 1 min elapsed from the onset of the CS, whichever occurred first. Four trials were run each day with a minimum intertrial interval of 4 hr. The components of the display occurring to the CS were recorded by the experimenter and at least one other observer on forms to facilitate speed and accuracy of recording. Inter-observer reliability was never less than 90% and usually higher for the first four components.

Conditioning criterion was four consecutive trials on which all five components of the courting patterns were elicited within the CS-US interval. When this criterion was met, extinction was begun on the next scheduled trial and carried out for four trials a day with the same intertrial interval as used in acquisition. Extinction trials were continued until no display components appeared to the CS for four consecutive trials. Twenty-four hours after reaching extinction criterion, trials were again run to test for spontaneous recovery of any display component. These were continued until the original extinction criterion was met.

Two subjects (S-4, S-5) were run as pseudo-conditioning controls. They were treated the same as the birds in the conditioning group with respect to habituation, deprivation, and intertrial interval. However, during the presentation of the stimuli, the CS and US were never paired. Instead, they were presented for 20 trials each, according to a Gellerman series (Gellerman, 1933). A 15-sec CS was used on the CS-alone trials, and on the US trials, the

female was placed in the brooder and allowed to remain for 1 min or until copulation occurred.

RESULTS

Figure 8-4 shows the acquisition of all five components of the display for the three experimental birds. All subjects quickly learned the response, with the acquisition of the individual response components varying little from bird to bird. Generally the components of the courting display were acquired in the following order: (a) increased neck and body tonus; (b) stiffening of the legs; (c) toe walking; (d) vocalization; (e) feather puffing. In extinction, the sequence of events was reversed in that the last component conditioned tended to be the first to extinguish and the next to the last to condition, the second to extinguish, and so on through the components; the first component showed the most resistance to extinction. Spontaneous recovery was observed only for component (a) for S-2 and S-3 and lasted for only one trial. Subject S-1 showed spontaneous recovery only for component (a) on the first two

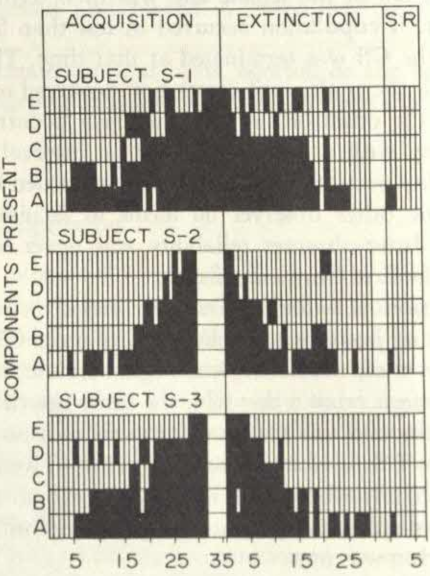

Figure 8-4. Acquisition, extinction, and spontaneous recovery of conditioned courting behavior using Japanese quail. Shown on ordinate are different components of the display: (a) increased neck and body tonus; (b) leg action; (c) toe walking; (d) vocalization; (e) feather puffing. Data presented are for components displayed during the CS-US interval.

test trials. At no time were any components of the display observed during the delay period between picking up the female and the onset of the CS.

Pseudoconditioning controls

The results of the pseudoconditioning controls showed that the CS (buzzer) alone did not elicit any components of the courting display. The only reaction observed to the CS alone was an increase in generalized activity. The birds habituated to this stimulus after several presentations. The presentation of the female to the control males consistently elicited the courting display, as it did with the experimental animals. At no time were any of the components of the display observed before the female was introduced.

DISCUSSION

The data from this study indicate that complex motor behavior of the type involved in the courting display of the male Japanese quail can be classically conditioned. Elements of the display began to appear to the CS alone as early as the fifth pairing of the CS and US. No components of the display occurred to the procedure attendant to handling of the female but only to the CS. This indicates that the buzzer alone served as a conditioned stimulus. However, in the trials approaching criterion, the male would occasionally exhibit a partial display to the experimenter when he first seated himself in front of the chamber. The individual components of the display conditioned progressively over trials. Only after a number of trials was each and every component elicited by the CS as a unit. This finding is similar to the individual component conditioning observed by Thompson and Sturm (1965) in the classical conditioning of the aggressive display in *Betta splendens*.

One of the most striking aspects of these data was the sequential orderliness with which the different components conditioned and extinguished across birds. As shown in Figure 8-4, the components condition in order (a) through (e) with all subjects, the only exception being S-3, when vocalization was elicited on several of the early trials. Likewise in extinction, the order of events was reversed with two exceptions; component (e) showed more resistance to extinction for S-1 and appeared on trials 15 and 16 for S-2. The sequence in which the individual components of the display were conditioned roughly paralleled that found by Farris (1964) in the ontogenetic development of the birds. In that study it was found that the first sign of courting behavior in the maturing male was increased neck and body action. The other components appeared as the male birds matured. It would be interesting in further research to investigate more fully the relationship observed between the emergence of the behavior during maturation and the sequence in which the response pattern appears during classical conditioning.

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9

EARLY SOCIAL EXPERIENCE

Chapters 7 and 8 included studies of the effect of social conditions experienced early in life on later affectional and sexual behavior. In Chapter 7 Cairns and Johnson (1965) reported that "exposure" of lambs to dogs produced attachment to dogs. In Chapter 8 Meier (1965) reported that monkeys raised with visual, auditory, and olfactory contact with other monkeys developed normal sexual and maternal behavior. The present chapter includes various studies dealing with the effects of early social experience, especially of social deprivation, on later social behavior.

In traditional psychotherapeutic thought, great emphasis is placed on early experience. The effects of early experiences are considered to be of overwhelming importance, and in many cases are considered irreversible. Although early experiences are undoubtedly important, absolute irreversibility has not been demonstrated experimentally. Severe deficits in stimuli during early life may lead to behavioral repertoires so deficient or disorganized that later learning may be virtually impossible. However, it appears unreasonable to assert that mother-child interactions at any specific age are crucial to later feelings of security or self-esteem. The true significance of social stimuli early in life remains to be determined. In the papers included in the present chapter, the effect of early experience is approached on an experimental level. The studies presented specify the early rearing conditions as well as the behavioral measures used as indicators of later development. The results are not as informative as one would wish, but a controlled experimental approach is necessary if the effects of early social experience are to be truly understood.

The first two papers presented study the effects of early social experience on later behavior of rhesus monkeys. The first paper is a continuation of Harlow's work on the infant-maternal affectional system of monkeys. The paper is by H. F. and M. Harlow and is entitled, "The effect of rearing conditions on

behavior." The Harlows raised infant monkeys under a variety of conditions: some monkeys were raised in total isolation; some were able to see and hear and smell, but not touch other monkeys; some had wire or cloth surrogate mothers; some had human handling. All of the monkeys raised under any of these conditions developed extreme behavioral abnormalities. They reacted abnormally to novel stimuli; they did not perform sexually in a normal manner, and the female monkeys who gave birth showed abnormal maternal behavior. In addition, the Harlows compared two groups of young monkeys, each allowed interaction with other young monkeys. Some of these monkeys had surrogate mothers; others had real mothers. Apparently, the interaction with the peer group of other young monkeys was sufficient to develop normal social behavior. Monkeys raised with surrogate mothers plus the peer group seemed to develop more slowly than monkeys raised with a peer group plus a real mother. However, when allowed to interact with peers, the monkeys raised with surrogate mothers and peers did not show the extreme behavioral abnormalities shown by monkeys raised only with surrogate mothers. The interaction with peers seemed to be of crucial importance. In fact, one of the mother monkey's most important roles seemed to be to encourage interaction with peers. The mother undoubtedly supplies many important social stimuli to the infant monkey; however, the peer group seems equally important to normal development.

The second paper included in this chapter compares the behavior of monkeys raised under two conditions of deprivation: complete isolation from all monkeys, and separation from monkeys. The paper is by W. A. Mason and R. R. Sponholz and is entitled, "Behavior of rhesus monkeys raised in isolation." As in Meier's study and in Harlow and Harlow's study, the separated monkeys were raised in wire cages and could see, hear, and smell, but not touch other monkeys. The totally isolated monkeys showed the extreme behavioral abnormalities observed by Harlow and Harlow. The behavior of the restricted monkeys, raised in wire cages, showed some abnormalities but was much closer to the behavior of normal monkeys. Little sexual behavior was observed in the restricted monkeys; however, the monkeys were tested in early adolescence, beginning at 16 months of age. Further experience and maturation might have corrected the sexual deficits. In tests for food competition between restricted and isolated monkeys, the restricted monkeys obtained nearly all the food. Harlow and Harlow grouped their isolated and restricted monkeys together and characterized the behavior of both as abnormal. They note that differences may exist between the behavior of the two groups; Mason and Sponholtz document these differences.

Results obtained with rhesus monkeys are put into perspective by the third paper included in the chapter. The paper is by S. C. Ratner and is entitled, "Comparisons between behavior development of normal and isolated

domestic fowl." Ratner raised two groups of chicks under identical circumstances with one important exception. The chicks in one group were raised as a social group, whereas the chicks in the other group were raised in total isolation. Many of the behaviors conventionally regarded as social developed in the isolated chicks. However, the development of the isolated chicks was much slower. Missing from the behavior of the isolated chicks were some of the aggressive behaviors important in establishing the social order in flocks of chicks. When the isolated chicks were assembled, these behaviors appeared almost immediately, although at first in a disorganized form. The aggressive interactions soon became normal and a typical social order was established.

When comparing the behavior of the chicks to that of the rhesus monkeys, the behavioral development of the chicks seems relatively independent of early social experience. Many of the behaviors thought to be social developed in the complete absence of social stimuli. Normal social interactions developed rapidly between chicks that had been reared in isolation. However, even in this species, whose behavioral development is relatively independent of experience, the effects of isolation at an early age are apparent in the retardation of development of the behaviors which occurred during isolation and in the disorganization of social behaviors when the animals were first allowed to interact.

Early experience in the form of "exposure" to other organisms does appear to affect later behavior. Within each individual experiment, the results are consistent. However, the details of the conditions that produce the results are not understood. Monkeys raised by Meier (1965) in wire cages showed normal sexual and maternal behavior, whereas monkeys raised by Harlow and Harlow in wire cages did not. Meier's cages were closer together than were Harlow and Harlow's, and Meier reported extensive social interaction between his monkeys. This social interaction, although without tactile stimulation, might have been the crucial factor in accounting for the differences in the behavior of the monkeys. However, when attempting to explain the development of complex social behavior on the basis of simple "exposure," the details of the relationships are difficult to determine. As Harlow and Harlow point out, "the exact mechanics are open for experimentation." Social behavior can be analyzed on a detailed level in terms of reinforcement and discriminative stimuli. At the present time, in experiments on the effects of early experience, no attempt has been made to achieve the controls over behavior and stimuli that would make such an analysis possible. Certain factors, such as the distance between cages, the amount of human handling, and the age of the organism have been specified. Nevertheless, the actual interaction between organisms has been left to the general control of the laboratory conditions and not subjected to experimental controls. Some critical distance between cages may exist for the development of successful

social interaction between monkeys. However, fortuitous circumstances, reinforcement of social behaviors, relationships of mutual reinforcement, and social discriminative stimuli are the stuff of which early social interaction is made. Understanding must eventually be achieved at this level.

The studies presented in this chapter demonstrate that the conditions of rearing do have an overall and persistent effect on the development of social behavior even though the details of the effect are missing. The studies clarify the significance of early social deprivation; other organisms do provide the stimuli that make normal development in animals, such as primates, possible. A detailed knowledge of these stimuli and of the conditions necessary for their presentation would contribute to the design of successful early social environments. Extended study of the socially deprived animals could be of immeasurable value in determining the persistence of the effects of deprivation and the conditions under which the deleterious effects could be altered.

The scientific study of the effect of early experience on human behavior has as yet been unsatisfactory. As Harlow points out, human infants cannot be deliberately subjected to the conditions of privation used in studies of the early social experience of animals. Yet conditions of privation are sometimes inflicted inadvertently, and the effects of these conditions can be studied in retrospect. The best-known of such studies was done by Bowlby (1953). The subjects were children who had been hospitalized for substantial periods of time under conditions which "amounted to solitary confinement." (p. 20). Bowlby reported that the children suffered behavioral abnormalities and deficits in intelligence, verbal behavior, and emotional behavior. Bowlby characterized the long-term effects of such early deprivation as an inability to respond emotionally to others and to form social attachments. According to Bowlby, "All children under about seven years of age seem to be in danger of injury, and some of the effects are discernible within the first few weeks of life." (p. 19). Bowlby attributes the deficits suffered by the children to a lack of mothering by a consistent care-taking figure during this supposedly critical period. In the hospital, one nurse cared for seven children, and the nurses changed from time to time. However, the extreme and general sensory deprivation suffered by the children would seem sufficient to account for the deficits shown by the children. The behavioral abnormalities produced in the children by the extreme isolation could themselves alter the children's later social experience to ultimately produce the long-term effects. Bowlby's results are frequently cited as evidence that the nuclear family situation, in which one mother consistently cares for only her children, is the most desirable type of early social experience. Experience in day-care centers or other group situations, no matter how rich the environment in comparison with the child's natural home, is often considered second best or actually damaging. However, neither the rearing conditions nor the behavioral results observed by Bowlby

have been in any way quantified or controlled. Obviously severe sensory deprivation of any human organism should be avoided. Nevertheless, the role of a mother in providing essential early social stimuli remains obscure. Observations such as Bowlby's provide valuable background information, but, as a basis for designing early environments for children, they lack specificity and objectivity.

Another, happier variation in the early experience of human infants is provided by some communal child-rearing arrangements, such as those found in Israeli *kibbutzim*. The fertility of the setting for retrospective speculation on the effect of early child-rearing conditions has not escaped psychologists. The latest well-known treatment of the subject was published by Bruno Bettleheim (1969) and is entitled *Children of the Dream*. Most traditional social psychologists characterize children raised in constructive communal settings as normal individuals, but as having a "sameness" or lack of the idiosyncrasies of children raised in nuclear families. J. L. Gewirtz has reported plans to quantify some of the variables involved in Israeli child rearing in communal settings and in nuclear families (Gewirtz and Gewirtz, 1969). Such an approach, if it could also specify some of the behavioral effects of the rearing conditions, could be of value.

Both from an intellectual and a practical standpoint, the most worthwhile attempts to understand the effect of early experience on human behavior may come from actual attempts to improve the rearing conditions of children. In homes and in institutional settings, attempts are being made to provide the early experiences that will lead to happy, effective human beings (Ulrich, Stachnik, and Mabry, 1970). Many of these attempts are made within the theoretical and methodological framework of this book. By systematically arranging conditions and measuring subsequent changes in behavior, a detailed, accurate account of human social development can be obtained. Early social experiences are undoubtedly of great importance in establishing social reinforcers and in developing social relationships such as cooperation and mutual reinforcement. Knowledge of the conditions that promote social development would not only contribute enormously to our understanding of human social behavior, but would make possible the rearing of children who obtain the best possible experience from their social world.

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The effect of rearing conditions on behavior

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and
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A wealth of clinical evidence shows that human children who have never had adequate maternal care or who have been separated from adequate maternal care within some critical stage, suffer disturbance and delay or even irreparable damage in terms of subsequent personal-social development. The importance of maternal ministrations in the child's development is further supported by many clinical investigations and by some limited experimental data.

Personality malfunctions that have been attributed to maternal inadequacy include such syndromes as marasmus, hospitalism, infantile autism, feeble-mindedness, inadequate maternal responsiveness, and deviant or depressed heterosexuality. If these disorders are the results of maternal inadequacy, only research with human subjects can establish the conditions and kinds of maternal behavior that produce them. Unfortunately, experiments critical to the resolution of these problems cannot be done with human subjects. We cannot rear babies in illuminated black boxes during the first half-year, year, or two years of their lives. We cannot have mothers rear their children in isolation from other children and from adults for the first two, four, or eight years. We dare not have human children reared with either no mothers or inadequate mothers while providing them with maximal opportunity to interact with age-mates, either identically reared or differentially reared. Yet these are the kinds of experiments which are required if we are to assess the effects of maternal variables unconfounded with other experimental variables on the child's personal-social development.

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Most clinical investigations have given primary attention to the effects of maternal privation, defined as absence or inadequacy of maternal responsiveness, or to maternal deprivation, defined as infant separation after the infant has established profound, or at least adequate, maternal attachments. Relatively little attention has been given to the effects of the absence or inadequacy of opportunity for the child to interact with other children and to form adequate affectional patterns with and for them. We know that it is important for the child to form effective infant-mother affectional patterns, but it also is likely that he must form effective child-child affectional patterns if he is to attain normal personal-social, sexual, and parental patterns. Obviously these affectional systems are not independent. It is possible, but by no means a certainty, that at the human level, normal child-child affection requires previous affectional bonds between mother or mother-figure and child. It is certain that the mother plays an important role in the formation of peer affections by providing for and encouraging such associations. Human mothers may also markedly influence the nature and course of child-child relationships.

Psychoanalytic theory, which looks for temporal reduction and temporal primacy, will ascribe primary importance to the earliest causes and conditions whether or not these are of greatest importance. Initial traumas have a false clarity as causative agents since they are not confounded by preceding events, whereas the role of all subsequent events is confounded by the role of these events operating during previous experience. Yet primacy in time need not, and often should not, be equated with primacy in importance.

EFFECTS OF TOTAL SOCIAL DEPRIVATION ON MONKEYS

Six years ago we took two newborn rhesus monkeys, one male and one female, and subjected them to total social deprivation for the first two years of life. Each was placed in a solid, illuminated cage such that it never saw any other animal—monkey or human—even though it was tested for food responsiveness and learning by remote-control techniques. During isolation these monkeys adapted to solid food slowly and learned with great difficulty, but they were found to have normal weight and good coats when removed—there were no signs of marasmus. At the conclusion of the two years' isolation, they were tested for social responsiveness to each other and to normal monkeys smaller and younger than themselves. They did not respond to each other and either froze or huddled in a corner in a room with many caged monkeys, they showed withdrawal from this new external world, and in the more than two years they lived together, they remained abnormally frightened, showed minimal interaction, and engaged in no sex activities. In follow-up social tests at four years of age with smaller and weaker monkeys, they made no

effort to defend themselves except for one brief episode with one of the pair, after which it curled into a ball and passively accepted abuse. The potential for social behaviors in these animals had apparently been obliterated.

We have preliminary, incomplete data on the effects of such total social deprivation confined to a six-month period and are obtaining other data on the effects of such deprivation over a twelve-month period. The results to date indicate severe but not complete withdrawal from external environmental stimulation. Repeated testing in our playroom situation, shown in Figure 9-1, reveals that one of these monkeys is almost totally unresponsive socially and the other only occasionally engages in brief, infantile-type social interactions. Normally, the playroom is a highly stimulating situation for monkeys. It is 8 feet high with 36 square feet of floor space, and it contains multiple stationary and mobile toys and tools, flying rings, a rotating wheel, an artificial tree, a wire-mesh climbing ramp, and a high, wide ledge, offering opportunities to explore and play in a three-dimensional world.

We also have data on eight monkeys subjected to total social isolation from other monkeys during the first 80 days of life. Although they neither saw nor contacted nor heard other monkeys, they did see and contact human experimenters, who removed them from their isolation boxes and tested them repeatedly on learning problems after the second week of life. A year later these animals appear to be normally responsive to external environmental

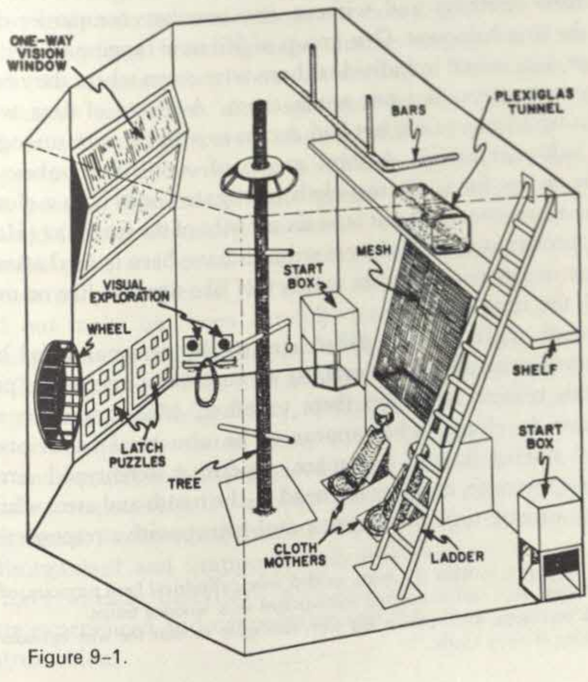

Figure 9-1.

stimulation and they are socially responsive to each other when tested in the playroom. This social responsiveness as measured by the appearance of increasingly complex play patterns has become qualitatively normal, but probably it is depressed somewhat quantitatively. Whether there will be subsequent effects on heterosexual and maternal behavior remains for future observation.

If we assume a rough developmental ratio of four to one for monkey to man, the results on these eight monkeys are not completely in accord with human clinical data, which at best are only roughly comparable to our experimental situation. Social isolation up to eight or ten months of age is reported to endanger or impair the personal-social development of human infants. It may be that the stimulation and handling of the monkeys in the learning experiments played a positive role in preparing them for subsequent exposure to a monkey environment, thus minimizing the isolation effects. It is also possible that the human infant is more susceptible than the monkey infant to damage from social isolation.

EFFECTS OF EARLY PARTIAL SOCIAL DEPRIVATION

We have data on various groups of monkeys raised from the day of their birth without their mothers and without any monkey companionship at least through the first half-year. One group of 56, now ranging in age from five to eight years, was raised in individual bare wire cages where they could see and hear other monkeys, but not touch them. A group of four was similarly housed for up to five years, but had access to a single wire surrogate[1] during the first half-year of life. A third group of over 100 monkeys was raised identically except for access to a cloth surrogate[2] or to both a cloth surrogate and a wire surrogate during at least six months of the first year (Harlow, 1958, 1959). Approximately half of these animals have been housed after six months or one year of age with another monkey of like age and like or unlike sex for part or all the time since.

Although there may be differences in the personal-social behaviors of the monkeys comprising these groups, we cannot be sure at the present time, and for this reason we group them together. Many members of all three groups have developed what appear to be abnormal behaviors, including sitting and staring fixedly into space, repetitive stereotyped circling movements about the cage, clasping the head in the hands and arms while engaging in rocking, autistic-type movements, and intrapunitive responses of grasping

[1] A wire surrogate mother is a bare, welded wire cylindrical form surmounted by a wooden head with a crude face and supported semiupright in a wooden frame.

[2] A cloth surrogate differs from the wire surrogate in that the wire cylinder is cushioned with a sheathing of terry cloth.

a foot, hand, arm, or leg and chewing or tearing at it with the teeth to the point of injury.

The sex behavior of the six oldest wire-cage-raised monkeys was first measured by Mason in 1960 and compared with that of rhesus monkeys of equal age which had lived in the wild during most of the first year of life. All the wild-raised monkeys, male and female, showed normal sex behavior, characterized in the male by dorsoventral mounting, clasping the legs of the female by the feet, and holding the buttocks by the hands. The females in turn sexually presented themselves by elevating their buttocks and tails, lowering their heads, and frequently looking backward without threatening. No laboratory-raised male or female showed normal sex behavior. Attempted mounting by the male was random in regard to body part, and the most frequent pattern was grasping a side of the female's body and thrusting laterally. The female's patterns were totally disordered and often involved sitting down and staring aimlessly into space. Although none of these animals were sexually mature, heterosexual positioning in both male and female normally develops during the second year.

Attempts to breed the cage-raised monkeys approximately two years later also ended in complete failure. When the oldest wire-cage-raised females were between five and seven years of age and the oldest surrogate-raised females were between three and five years, repeated attempts were made to breed 11 of the wire-cage-raised females and four of the cloth-surrogate-raised females with highly selected males from our breeding colony. The females were placed in the large breeding cages during estrus, and if no fighting ensued within 15 minutes, they were left overnight. Eventually one wire-cage-raised female and three cloth-surrogate females became pregnant. Although observation did not reveal clear-cut differences in the behavior of these two groups, the differences in pregnancy approach significance in spite of—or possibly because of—the greater immaturity of the cloth-surrogate-raised females. Actually, no female, impregnated or not, demonstrated a normal pattern of sexual behavior. Many females tried to avoid the males; some actually threatened the males and would probably have been injured had our males not been carefully screened. When the males approached and positioned the females, the females usually collapsed and fell flat on the floor. Impregnation of the four females was achieved only through the patience, persistence, knowledgeability, and motor skill of the breeding males.

We have subsequently tested many wire-cage- and surrogate-mother-raised males and females with experienced breeding females and experienced breeding males, respectively, in a large 8-foot by 8-foot by 8-foot room especially designed for breeding studies. All the males have continued to show the disorganized and inappropriately oriented sexual responsiveness which we have already described, and no male has ever appropriately mounted our experienced and cooperative breeding-stock females, let alone achieved intromission.

With a single exception we have never seen normal, appropriate sexual posturing in our wire-cage- or surrogate-raised females. The females do not approach the males, nor do they groom or present. One cloth-surrogate-raised female was not impregnated throughout six mating sessions, and during this time she began to respond positively and appropriately to the males and eventually developed a normal, full-blown pattern of sexual presentation and sexual posturing during copulation.

EFFECTS OF MATERNAL CONDITIONS

Direct comparison of the effects of being raised by real monkey mothers and cloth surrogate mothers on subsequent personal-social development has been measured by the use of our playpen test situation. In two playpen situations babies were housed with their real mothers, and in a third setup the babies were housed with cloth mothers. The playpen, whose floor plan is given in Figure 9-2, consists of large living cages each housing a mother and an infant and adjoining a compartment of the playpen. A small opening in each living cage restrains the mother, but gives the infant continuous access to the adjoining playpen compartment. During two daily test sessions, each an hour in length, the screens between playpen compartments were raised, permitting the infant monkeys to interact as pairs during the first six months and as both pairs and groups of four during the second six months. Two experimenters independently observed and recorded the behavior exhibited during test sessions.

The infants raised by real monkey mothers were more socially responsive to each other than were the infants raised by the cloth surrogates. They

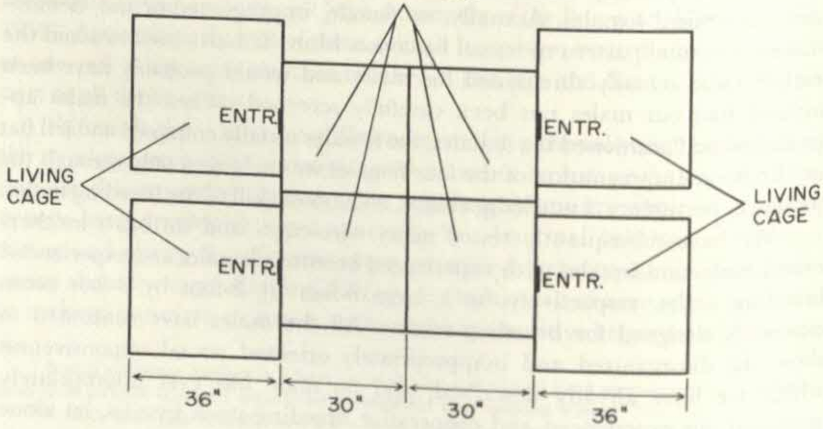

Figure 9-2.

showed a wider range of facial expressions, and, probably of paramount importance, they developed simple interactive play patterns earlier than the surrogate-raised monkeys and achieved a level of complex play patterns not achieved by the surrogate-raised monkeys during an 18-month test period.

All the male, mother-raised infants have at one time or another responded sexually toward the mother with pelvic thrusting and in at least two cases by dorsoventral mounting. In three cases pelvic thrusting to a female was observed before 50 days of age and in a fourth case, before 100 days of age. Only two (one male and one female) cloth-surrogate-raised monkeys were observed to show pelvic thrusting to the surrogate, and this occurred initially at approximately 100 days of age. Frequency of this sexual play was much higher toward real mothers than toward surrogates. In both situations maximal frequency occurred at about five months and then declined, apparently being superseded by thrusting directed toward other infants.

Surrogate babies and mothered babies showed no significant differences in first-observed, infant-directed thrusting, but the actual mean score of the surrogate group was lower. The frequency of sexual play was higher for the real-mothered babies than for the surrogate babies. Finally, seven of eight mother-raised monkeys showed appropriate adult-form sex behaviors during the first 18 months, including ankle clasp by the males, whereas adult-oriented sex behavior was not observed in the cloth-surrogate-raised babies.

There is every reason to believe that normal mothering facilitates the development of heterosexual behavior in rhesus monkeys. This may be in part the result of direct contacts with the mother growing out of the intimate bonds between mother and child. One must not, however, underestimate the importance of the role which the real mother apparently plays, indirect though it is, in stimulating the infants to associate with other infants. This is accomplished from the third month on by discouraging the infant from constant clinging as it matures. From time to time the mother restrains the infant's approaches or cuffs it if it nips her or pulls her hair. The chastised infant seeks the companionship of other babies until the storm subsides—the other mothers by this time generally reject all but their own babies—and in the infant-infant interchanges, strong affectional bonds develop along with behaviors, sexual and nonsexual, appropriate to the sexes.

In the present study, as in all ordinary human situations, there is confounding in the roles played by the mother-infant affectional systems and the infant-infant and peer-peer affectional systems in determining later behavior. We expect to resolve this in part by raising two groups of monkey babies with real mothers, but denying them any opportunity to interact with other infants for six months in the one group and 12 months in the other before subjecting them to social testing.

Some information is supplied by another experiment involving eight rhesus babies raised on cloth surrogate mothers, but tested 20 minutes a day in the playroom, which is a more stimulating environment than that afforded

by the relatively cramped and bare confines of the play compartments of the playpen situation. These surrogate-mothered babies showed excellent and appropriately timed play behaviors and very early came to assume both sexual and nonsexual behaviors appropriate to males and females. The males threatened, the females did not; the males initiated rough-and-tumble play, but not the females. Males chased males and males chased females, but females practically never chased males and seldom chased females. By a year of age considerable appropriate male and female sex behavior had occurred, and full and complete copulation, other than insemination, was repeatedly observed in the two males and two females on which observations were continued during the second year of life.

It is obvious that we must not underestimate the importance and role of the infant-infant affectional system as a determiner of adolescent and adult adjustments. It is more than possible that this system is essential if the animal is to respond positively to sheer physical contact with a peer, and it is through the operation of this system, probably both in monkey and man, that sexual roles become identified and, usually, acceptable.

The role of the mother in the formation of the adult personality is obviously important, but the exact mechanics are open for experimentation. The most tender and intimate associations occur at a stage in which the monkey infant and human infant can to a considerable extent be molded. Monkey and human mother both have the obligation of gradually dissolving the intense physical bonds which characterize the early mother-child relationship. For the monkey mother it is easy and natural—when the infant becomes mature enough and strong enough to become bothersome, she rejects or punishes it and the baby retreats for a time. Subsequently, she welcomes the baby back. Independence is gradually established. For the human mother, with her more complicated motivational systems and her complex culture, it may be difficult to achieve this gradual separation. The overprotective mother is a well-known clinical extreme in the human problem of weaning the infant and child emotionally. Probably the surrogate monkey mother is a parallel of the overprotective human mother, failing usually to equal the normal mother in rearing socially and sexually adjusted monkeys because, at least in part, she is ever available to provide comfort and security. She never discourages contact and thereby never encourages independence in her infant and affectional relationships with other infants and children. The normal state of complete dependency necessary in early infancy is prolonged until it hinders normal personal-social development.

As we have already pointed out, four of our laboratory-raised females never had real mothers of their own, one being raised in a bare wire cage and three with cloth surrogates. The first week after the birth of the baby to the wire-cage-raised female, the mother sat fixedly at one side of the cage staring into space, almost unaware of her infant or of human beings, even when they barked at and threatened the baby. There was no sign of maternal responses,

Figure 9-3.

and when the infant approached and attempted contact, the mother rebuffed it, often with vigor, as shown in Figure 9-3.

The next two unmothered mothers constantly rebuffed the approaches of their infants, but, in addition, frequently engaged in cruel and unprovoked attacks. They struck and beat their babies, mouthed them roughly, and pushed their faces into the wire-mesh floor. These attacks seemed to be exaggerated in the presence of human beings, and for this reason all formal testing was abandoned for three days for the third unmothered mother because we feared for the life of the infant. The fourth unmothered mother ignored and rejected her infant but did not exhibit excessive cruelty.

In strong contrast to the frailty of the maternal affectional system was the vigor and persistence of the infants' bondage to the mother—time after time, hour after hour, the infants returned, contacted, and clasped the

mother in spite of being hit, kicked, and scraped unceremoniously off the mother's body, as shown in Figure 9-4. The physical punishment which these infants took or sought for the privilege of brief contact even to the back or side of the mother's body testified to the fact that, even in infants, attachment to the mother may be prepotent over pain and suffering. One

Wisconsin Regional Primate Center

Figure 9–4.

could not help but be reminded of children, removed from indifferent or cruel, indigent, and alcoholic parents, whose primary insistent wish is to return home.

The degree to which monkey data are generalizable to the human being will remain an unsolved dilemma. Nevertheless, we are so struck by the many apparent analogies that we are tempted to say the monkey experiments give us faith in the human clinical observations.

SUMMARY

Infant rhesus monkeys have been reared starting on the first day of life in a variety of situations, including total isolation; partial isolation, either in individual bare wire cages in a colony room for two years or longer, or in individual wire cages with access to one or two mother surrogates for at least the first six months; and in situations with real or surrogate mothers plus contact with other infants for the first year or two of life.

Total isolation for two years resulted in failure to display social or sexual behavior in the next two years, spent in a joint living cage. Results on six months of such isolation are still being gathered and suggest severe, but not complete, social deficits. Only mild effects have been observed thus far in monkeys isolated through the first 80 days of life.

Partial isolation has produced behavioral aberrations in many monkeys and sexual inadequacy in all males and in all but one female. Four females were impregnated, in spite of inadequate posturing, and proved to be completely inadequate mothers.

Infants raised by live mothers were more advanced in social and sexual behavior than infants raised by surrogate mothers in a controlled playpen situation. The mother's role is not entirely clear, however, because in a more stimulating playroom situation, surrogate-mothered babies have shown normal social and sexual behavior.

Overall, it appears that the longer and the more complete the social deprivation, the more devastating are the behavioral effects. Further research is needed to evaluate the relative contributions of live mothers and infant companions to later adjustment.

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Behavior of rhesus monkeys raised in isolation

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and
R. R. Sponholz

A large number of animal studies have demonstrated the important influence of experience acquired during infancy and childhood on later behavior. (For reviews see Beach and Jaynes (*1*), and Denenberg (*2*).) In his discussion of parameters relevant to studies concerning the effects of early experience on adult behavior patterns, King (*3*) recognizes seven variables as particularly significant. Among these are included (a) the duration or quantity of the experience; (b) the type or quality of the experience, and (c) the type of performance measure obtained.

This report is primarily concerned with the effects of the second of these factors, the type or quality of the experience, on the social and manipulatory responsiveness of young rhesus monkeys. In previous studies the social behavior of adolescent monkeys raised from infancy in individual wire mesh cages was compared with the behavior of wild-born animals the same age. Laboratory-reared monkeys fought more than feral animals, groomed less and were deficient in their sexual performance (*4*). In the present experiment the behavior of pubescent monkeys reared in the ordinary laboratory environment, as were the restricted subjects of the earlier experiment, is compared with the behavior of monkeys exposed from infancy to a more severe form of environmental restriction.

METHOD

Subjects

The subjects were 4 pubescent rhesus monkeys. There was one male and one female in each group. All animals were between 15 and 16 months old when the present experiment began and between 21 and 22 months old when they were permanently removed from their regular living cages for the final phase of testing. None of them had had previous exposure to any of the test situations.

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Rearing conditions

All animals were separated from their mothers at birth and housed individually in cages providing a living space 24 in. × 18 in. × 15 in. Two monkeys (restricted monkeys) were maintained in wire mesh cages in a room where they could see and hear other monkeys. They had no direct contact with other animals, however, and their contacts with human beings were limited to routine testing and caretaking activities.

The two remaining monkeys (isolates) were housed alone from birth in enclosed cages which minimized all contact with the extra-cage environment. A schematic view of an isolation cage is shown in Figure 9-5. The cage included a living space and two stimulus presentation compartments, one at each end of the living space. The ceilings of these compartments were constructed of translucent white plexiglas and illumination of the interior of the compartments and of the living space was provided by two 25-W bulbs, one placed above each compartment. Access to the stimulus presentation compartment from the living space was through horizontal bars and sliding opaque screens could be lowered between the living space and the presentation compartments, thus permitting the animals to be maintained and tested in complete social isolation (*5*). Ventilation was provided by a blower which also served as a partial masking noise. The isolation cages were placed in a

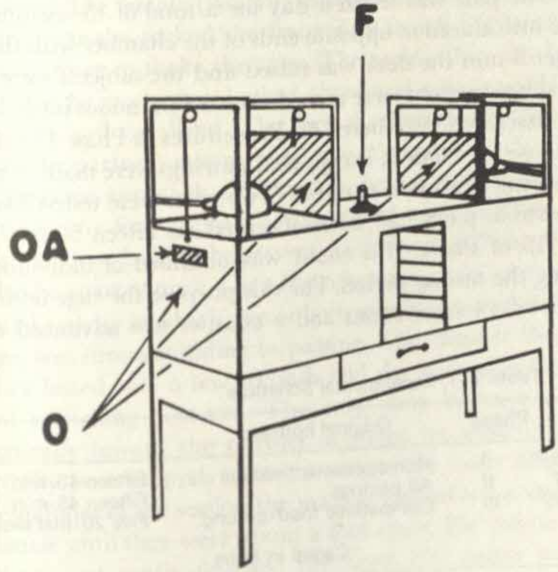

Figure 9-5. Isolation cage. OA, observation aperture; O, opaque screens; F, opening and holder for feeding tube. An opaque door covered the opening at the side of the cage.

room which was separate from the nursery proper. The isolates were tested for manipulatory responsiveness during the first 90 days of life (*5*) and one of them was tested on various discrimination learning tasks starting when it was about 5 months old (*6*). Performance in these situations compared favorably with data for non-isolated monkeys of similar age.

Apparatus

Until the final phase of testing the monkeys were observed in a chamber 6 ft long, 2 ft wide and 30 in. high. It was framed in angle iron and had a front of clear plastic. A sliding opaque door could be lowered to divide the cage into two sections, each 3 ft long. For competitive food-getting tests a short length of tubing with a cup formed at one end was inserted at each end of the chamber. For the last phase of testing the monkeys were placed in pairs in expanded metal cages (30 in. × 30 in. × 30 in.) within a colony room. The cages were shielded to prevent visual contact with other animals. One-way vision screens were used throughout to prevent the subjects from seeing the observer.

Procedure

The experiment was conducted in four phases, shown in Table 9-1. In Phase I (homogeneous pairs) isolates and restricted monkeys were paired only with each other. One pair was tested a day for a total of 15 sessions a pair. The animals were introduced at opposite ends of the chamber with the center door lowered. After 5 min the door was raised and the subjects were observed for 45 min. Social interactions were recorded on a continuous inkwriter according to a method described elsewhere (*4*). Procedures in Phase II (all pairs) were identical to those for Phase I, except that pairings were made across as well as within the rearing condition variable. Two pairs were tested daily until each of the six possible pairs had been observed on fifteen 50-min sessions. On sessions 3 to 15 of Phase II a count was obtained of individual locomotor activity during the testing period. For this purpose the cage floor was marked off into 18 in. × 24 in. sections and a counter was advanced each time an

Table 9-1. Experimental Schedule

Date	Phase	Original housing	
6/17 to 7/26	I	Homogeneous pairings	Fifteen 45-min. sessions/pr.
7/30 to 9/27	II	All pairings	Fifteen 45-min. sessions/pr.
10/2 to 11/27	III	Competitive food-getting	Five 20-trial sessions/pr.
		Caged in Pairs	
12/9 to 12/22	IV	Homogeneous pairings	Twenty 5-min. sessions/pr.
12/23 to 1/19		Mixed pairings	Twenty 5-min. sessions/pr.

animal entered a section up to the midline of its body. On the last five sessions all manual and oral contacts with the environment were noted. Phase III tested competitive food-getting. Each of the six pairs was tested for five sessions. A total of 20 grapes was delivered in each session, with the position of the rewarded food chute alternating by blocks of five trials.

The original housing was maintained through Phase III. The monkeys were brought to and from the observation chamber in small carrying cages, which for the isolates were completely enclosed. Upon completion of Phase III, the animals were housed in pairs in expanded metal cages. The pairs were homogeneous during the first two weeks and new pairs were formed every two weeks. Each pair was observed for a total of twenty 5-min sessions, five times in the morning, ten times in the early afternoon and five times after 9 p.m. Behavior was recorded by 15-sec intervals on a time-ruled check sheet (*10*). During the first (homogeneous) pairing a 13-in. furnace chain with a ring at the end was attached to a counter bolted to the top of each cage to provide data on manipulatory activity.

RESULTS

Homogeneous pairings

The isolates appeared to be traumatized by the situation and spent the majority of the time crouching at opposite ends of the cage, clutching themselves and rocking. The female (No. 19) usually sat in the corner facing away from her partner. As she rocked she frequently struck her head against the wall with enough force to shake the cage. The male's (No. 20) behavior was similar except that he more often looked about and occasionally lipsmacked, drew back his ears and vocalized. The formal criterion of a social approach (within 6 in. of the partner) was met on only 25 occasions (five sessions). In almost every instance approach appeared to be adventitious. For example, on session 9 when the first approach was scored both animals were sitting next to the center door before the session started and fell together as it was raised. They broke apart at once. On a few other occasions approach occurred during a burst of activity in which one or both monkeys would dash frantically across the cage, sometimes colliding in passing. The cause of these episodes is unknown. They lasted only a few seconds and the animals quickly returned to their usual crouching postures. The only clear instance of a response directed specifically toward the partner occurred on session 12. Following a burst of activity both animals came to rest on the same side of the cage. During the remainder of the session the male advanced a few inches at a time toward the female until they were about a foot apart. He then leaned toward her several times and gently touched her head. She made no response to contact initially, then withdrew.

The behavior of the restricted monkeys contrasts sharply with this

picture. Locomotor and manipulatory activity were high throughout. Although the restricted monkeys also displayed the syndrome of crouching, self-clasping and rocking, this comprised a much smaller portion of their total behavior than it did for the isolates. Their social behavior conformed in most respects to the general pattern described for restricted monkeys (*4*). They were scored with 527 approaches and both animals exhibited play, grooming and aggression. On a few occasions the male (No. 23) attempted unsuccessfully to mount the female (No. 22), but he more often engaged in autoerotic behavior, usually by thrusting against his leg. He frequently became highly excited and danced about the cage, biting himself and pulling at his hair. These displays usually culminated in an attack on the female. At first aggression was shown by both animals, but by session 3 it was apparent that the male was dominant and thenceforth he initiated most of the approaches and all of the aggression, while the female generally withdrew from contact. Social facilitation of environmental manipulation (*4*) occurred on 91 occasions and was displayed by both animals. The female, however, usually waited until the male ceased to manipulate and had moved away before approaching the scene of his activity and engaging in similar behavior.

All pairings

When tested together in Phase II the restricted monkeys showed no important change from the pattern already described. The male continued to be the aggressor and made 502 approaches, compared to 33 for the female. Both animals received high scores for locomotion (No. 22 = 6910; No. 23 = 4900) and for manipulation of the environment (No. 22 = 279; No. 23 = 617). The isolates also behaved together much as they had during the previous phase. They were scored with 12 approaches (on five sessions), all apparently adventitious. As would be expected, locomotor activity was low (No. 19 = 8; No. 20 = 89), and manipulation of the environment was infrequent (No. 19 = 22; No. 20 = 14). In mixed pairings the behavior of the isolates reflected the activities of their partners. With the active and aggressive restricted male the isolates were initially passive and either submitted to rough treatment or made ineffectual attempts to push him away. They showed no counter-aggression. Within a few sessions both isolates adopted a pattern of with-

Table 9-2. Total frequency of responses for mixed pairs. Phase II

	Pairs							
	A		B		C		D	
	19(I)	22(R)	19(I)	23(R)	20(I)	22(R)	20(I)	23(R)
Locomotion	56	662	2453	3906	101	912	3025	3096
Manipulation	36	58	47	493	8	105	10	430

drawing whenever the restricted male approached. This resulted in high activity scores and in rank-order correlations greater than 0·90 between their withdrawal responses and his approaches. Because the restricted female made few approaches, the locomotor scores of the isolates when paired with her were only slightly higher than when they were paired with each other. Table 9-2 presents data for locomotion and environmental manipulation for each isolate-restricted pair.

Competitive food-getting tests

Little new information was yielded by competitive testing. In mixed pairings the restricted monkeys obtained 81 per cent of the food. The male entered both sides of the cage freely with all partners and clearly dominated the situation. The restricted female was more cautious. When paired with the restricted male she took food only when he was away from the food chute and always withdrew when he approached. She took all of the food delivered to her side of the cage when she was with the isolate male and she made hesitant approaches toward his side of the cage which caused him to vocalize, deterring her from going further. She entered both sides of the cage when paired with the female isolate and received all of the food. Both isolates tended to remain at one end of the cage unless approached by another animal and the primary difference between them was that the male took food when it was uncontested, while the female remained crouching almost continuously and took food only once.

Observations in living cages

During the entire period in which they were together the isolates generally avoided each other and were much less active than the restricted monkeys. Table 9-3 presents totals for homogeneous pairs for measures of crouching, locomotor activity, initiation of social contacts and manipulation of the environment and chain. Table 9-4 presents similar data on each animal for mixed pairings. Data are also included for aggression, withdrawal from social contact, passive acceptance of social contact and grimaces (believed to indicate fear or submission (*7*). To provide some indication of the consistency of differences between members of a pair, sign tests were performed comparing

Table 9-3. Total frequency of response for homogeneous pairs. Phase IV

	Isolate	Restricted
Locomotion	175	512
Crouch	334	202
Initiates Contact	4	64
Manipulates Environment	141	251
Manipulates Chain	218	5248

Table 9-4. Total frequency of responses for mixed pairs. Phase IV

	Pairs							
	A		B		C		D	
	19(I)	22(R)	19(I)	23(R)	20(I)	22(R)	20(I)	23(R)
Locomotion	77	257**	209	365**	178	275*	80	262**
Crouch	275	177**	109	50*	211	104**	304	167
Initiates Contact	1	3	0	162**	0	69**	0	111**
Aggression	0	0	0	113**	0	43**	0	69**
Passive	3	0	77	0**	24	0**	32	0
Withdrawal	37	0**	203	0**	92	6**	73	0**
Grimace	3	0	110	0**	56	0**	69	0**
Manipulation	86	94	16	172**	75	112*	20	114**

*$p < .05$. **$p < .01$.

responses over twenty sessions. The restricted monkeys received higher scores for locomotor activity, manipulation of the environment, and all social responses except withdrawal. The isolates were consistently higher in withdrawal, passive acceptance of social contact, crouching and grimaces.

Following the final series of observations the animals were separated and housed individually in expanded metal cages in a room with other monkeys. Non-systemic observations of the isolates made over a period of months gave no evidence of any important change in their behavior. One of us (R. R. Sponholz) had an opportunity to observe the isolates in social pairings after they had been exposed to the normal laboratory environment for about two years. Their behavior was essentially similar to the patterns already described.

DISCUSSION

While the number of animals used in this experiment is small, the results suggest that monkeys kept in isolation until early adolescence are severely and persistently handicapped in their ability to cope with other monkeys and with novel situations. The isolates' behavior can perhaps best be described as a form of traumatic withdrawal. Crouching was their characteristic posture during more than 1000 hr of exposure to the test situations. Few responses were directed toward other animals or the physical environment and the most common reactions to social contact were submission or flight.

It should be emphasized that the behavior of neither group was normal, compared to wild-born monkeys. All animals displayed the syndrome of crouching, self-clasping, thumb-sucking and stereotyped rocking which is characteristic of socially deprived monkeys and apes, particularly in stressful situations (*8–11*). Thus, the important contrast between groups is not in the presence or form of these behaviors, but rather in the lack of other responses in the isolates. This is especially interesting because the isolates gave no

indication of unusual behavioral constriction when they were observed and tested while living in their original isolation cages.

The persistent failure of the isolates to adapt to the extra-cage environment is probably related to two factors: One of these is the age of the animals when they were first removed from isolation (early adolescence) and the other is the contrast between the rearing environment and the test situations. While the specific test conditions used in this experiment were new to both groups, the restricted monkeys had experienced from birth a more complex and changing environment, including some exposure to situations other than the living cage, and they had had almost continuous visual contact with other monkeys. This experience was presumably a major factor facilitating their adjustment to the test situations.

SUMMARY

1. Two rhesus monkeys (isolates) were raised in enclosed isolation cages from birth until early adolescence (16 months). Two additional monkeys of the same age, raised routinely in wire mesh cages, were used as a comparison group (restricted monkeys).

2. Isolates were paired with each other and with restricted monkeys in various phases of the experiment and in all received more than 1000 hours of exposure to the test situations.

3. The isolates appeared to be traumatized by the extra-cage environment. Crouching was their characteristic posture throughout the experiment. Few responses were directed toward other animals or the physical environment and the most common reactions to social contact were submission or flight.

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were raised in isolation from each other. For these purposes, two circular brooders were constructed to house the groups. The circular design was selected because it provided identical living space for all isolated birds, it permitted easy observation during isolation, and it could be converted into the area in which the isolated birds would live after they had been assembled. Each brooder was constructed of wire and was 5 feet in diameter, 1 foot high, and was elevated 2 feet above floor level. A water tray was located at the centre of the brooder and 14 small food trays were spaced equally along the outside perimeter. Heat was provided for each group by a circular metal plate on the floor of the brooder. The plate extended beyond the water tray and was heated by an infra-red bulb which was moved progressively farther from the plate as the birds matured.

The birds in the normal group were maintained in one circular cage brooder until 82 days of age. Food and water were continuously available. The birds in the isolated group were maintained in another circular brooder which was located 10 feet from the brooder of the normal group. A permanent, opaque screen separated the two brooders. The brooder used for the isolated birds was identical with the one used for the normals with the exception of plywood radius walls that divided the area into 14 equal isolation sectors. Each sector was wedge shaped, 12 inches wide at the base and 25 inches long. Each plywood wall fitted tightly from the floor of the brooder to the top and from the outside to the centre. A baffle at the water tray, which was located at the centre of the circular brooder, prevented birds from seeing each other. Thus, the isolated birds could hear others but could not see or touch them during the period of isolation.

The data on the behavioural development of the normal White Leghorns were obtained from 42 observation periods which were spaced from 1 to 3 days apart when the birds were 2 through 82 days of age. The observer remained 8 to 10 feet from the brooder and made detailed notes on the birds' responses, antecedent conditions for these responses, and identifying marks of the bird. One bird in the normal group was removed when it was discovered it had been incorrectly sexed. The data on the behaviour development of the isolated birds were obtained on the same schedule as that used for the normals. The order of observing the groups was changed from day to day. On half of the days the isolated group was observed first; on the other half the other group. Birds in both groups saw humans during feeding, watering, weighing, and observation periods. However, no extra eliciting stimuli, such as hands or dummy birds, were presented to either group.

Several times during the course of the study both groups of birds were weighed to provide an index of the health of the two groups. During weighing and at all other times care was taken to keep the isolated birds from seeing others and handling was kept to a minimum.

When the birds were 70 days of age, the isolated birds were all removed from their sectors in the brooder. The walls which made the sectors were

removed while birds were kept in individual boxes. The isolated birds were then returned to the brooder from which the walls had been removed. The return of all the birds required 1 minute, after which the newly assembled group was observed continuously for 2 hours. Two observers were used and each recorded different classes of behaviours. Daily observations were continued until the birds were 82 days of age.

MEASUREMENT

A wide variety of behaviours were observed and recorded in the present study. However, the principal interest was in behaviours which occurred prior to social organization, which appeared to involve other birds during development under normal conditions, or which would involve other birds at later stages in development. Four classes of behaviours previously defined by Guhl (1958) were used, and several additional classes were identified. One or both of the following criteria were used to specify a class of behaviours: (1) the form of a previously observed behaviour changed, for example, by the addition of new movements; (2) the function of a previously observed behaviour changed in terms of its consequences or antecedent condition, for example, a response previously elicited by a wide variety of stimuli came to be elicited by only a specific stimulus. The age at which a behavior was reported to occur was set at the age at which the first bird showed the behaviour. The peck order was assessed by the method previously described by Ratner (1961).

RESULTS

Behaviour development of the White Cobbs

The main findings from the first study are summarized in Table 9-5 which shows the behaviour classes, defining characteristics, and ages of occurrence of social behaviours for the 21 White Cobb chicks which were raised together.

Table 9-5. Behaviour classes, defining characteristics, and ages of occurrences of social behaviours for White Cobb cockerels

Behaviour class	Characteristic	Age of occurrence in days
Frolic	Run with raised wings	3
Frolic with object	Hold object and run with raised wings	9
Spar	Short run and jump toward another bird	10
Food dominate and food submit	Push and displace another bird at food tray	13
Aggressive peck and submit	Peck at head of another; pecked bird moves away quickly	18
Juvenile fight	Short run and jump toward another with feet thrust forward	23

Frolicking, as defined by Guhl (1958), was conspicuously present during the first week of the birds' lives. Typically, when one bird made the response others responded in the same fashion. While no external stimulus was observed that was reliably associated with the response of the initiating bird, the birds in the area clearly reacted to the initiator. The frolic for one individual terminated as abruptly as it started after 2 to 4 runs across the cage. Different birds in the brooder initiated the reaction at different times. During the second week, frolicking gave way to *frolicking with an object*. In this case, one bird caught some object, such as a scrap of paper or a feather, and ran with raised wings with this object in its beak. Then others pursued the bird and struggled for the object. If one got it, it ran and was pursued. This pattern occurred during the second and third week after which time it could no longer be elicited even by dropping objects into the brooder. The abrupt termination of frolicking with an object may have been due to the fact that non-edible objects were involved and bilateral relations between birds were changing into unilateral dominance relationships.

Shortly after the time when frolicking with an object was observed to occur, *sparring* was also observed. Guhl described sparring in much the same way as we observed it: "Two chicks after frolicking, jumped up and down, as adults do when fighting, but fail to deliver any blows with their beaks" (Guhl, 1958). It was consistently noted that the spar was preceded by a short run of two or three steps by the initiating bird toward another. This led the approached bird to make the return spar. The condition which led the initiator to the response could not be determined with certainty, although it seemed to involve a raised head, upright posture, and proximity on the part of the approached bird.

At the end of the second week, *dominant and submissive behaviours at the food tray* were evident. This behaviour was different from the bilateral pushing that occurred previously. Individual birds began to occupy particular areas at the food tray and by a small push moved others from this area. Another behaviour which was observed by the eighteenth day was *aggressive pecking and submitting to the peck*. This pecking was different from *generalized pecking* that occurred within the first week and was directed at most small objects including the eyes and toes of other birds. In aggressive pecking the reaction of the receiver was different from that showed earlier in the birds' lives and the peck was delivered with considerable vigour and confined to the head of the receiver. While pecking at the backs of other birds continued, such pecks occurred with less vigour.

Between the ages of 20 and 30 days, a total of 146 aggressive pecks were observed, of which 33 were reciprocal and 113 were unilateral. The preponderance of unilateral relationships from the period after 18 days of age was considered as additional evidence that such pecking is different from that classified as generalized pecking.

The *juvenile fight*, although not mentioned by Guhl (1958), was frequently

observed during the fourth week of age. It looked much like sparring with the addition of the more mature pattern of thrusting the feet forward. As with sparring, the initiating stimulus was not obvious, but the behaviour of one bird reliably led the other to make a similar response. As noted in Table 9-5, aggressive pecking did not occur with juvenile fighting.

Movements involved in food getting and care of the body surface were also noted. Generalized pecking elicited by the sight of small, round objects occurred immediately after receipt from the hatchery. This type of response declined in frequency so that by 7 days of age the birds were pecking at specific objects associated with food. Scratching at food and the wire occurred at 10 days of age. Preening and bill wiping occurred for the first time at 12 days of age.

Behaviour development of the normal and isolated White Leghorns

The schedule of behaviour development of the normal and isolated groups is shown in Table 9-6. The left column shows the ages of occurrence of classes of social behaviours for the normal group of White Leghorns. It can be seen that the arrangement of behaviour classes by age, which was derived in part from Guhl's report (1958) and from data on the White Cobbs, is well substantiated by the data from the normal White Leghorns. Every bird in the normal group made the responses of frolicking, frolicking with an object, sparring, and juvenile fighting.

The behaviour development of the isolated group during the period of isolation is shown in the right column of Table 9-6. Several aspects of the data are of particular interest: (1) four of the classes of responses which are considered as social responses were shown by the birds during isolation; (2) these responses occurred with some delay as compared with the normal group.

The form of each of the responses shown by the isolated birds was judged to be identical with that shown by the normals. That is, the movements of the birds in the two groups were similar, although no specific or usual eliciting stimuli were presented to the isolated birds at any time during isolation.

Table 9-6. Behaviour classes and ages of occurrences of social behaviour for the normal and isolated White Leghorns

Behaviour class	Age of occurrence for normals in days	Age of occurrence for isolated in days
Frolic	2	3
Frolic with object	6	36
Spar	10	14
Aggressive peck	17	—
Threat	19	—
Juvenile fight	24	36
Fight with pecks	36	—

All birds in the isolated group made all of the responses noted in Table 9-6 with the exception of frolicking with an object. This response was shown by only 4 of the 14 birds. In addition, the birds in the isolated group showed characteristic responses associated with feeding and care of the body surface. These responses occurred at the same ages for the isolated birds as for the normal birds.

BEHAVIOUR OF THE ISOLATED GROUP AFTER ASSEMBLY

Twelve seconds after the 70-day-old birds of the isolated group were assembled, the first aggressive interaction took place. This was quickly followed by a large number of pecks, threats, fights, retreats, and avoids involving each of the 14 birds. However, the behaviours which occurred immediately after assembly differed in several respects from those shown by the normal birds of a similar age: (1) the entire group was greatly agitated and individuals dashed from place to place alternately crouching, pecking, and avoiding for more than 2 hours after assembly; (2) those birds that pecked and fought were indiscriminate in pecking the backs, wings, and heads of others; (3) within 1 hour, 3 birds were dominating all of the others and fighting among themselves; (4) a total of 150 pecks were recorded within the 2 hours immediately after assembly, and it is estimated that another 50 to 100 occurred, but could not be recorded.

The locations of the birds in the brooder during the period immediately after assembly were also noted. It was thought that each bird might remain near and defend the area where it had lived and eaten. As suggested above, this was not true. The birds moved from food cup to food cup, particularly when others approached.

On the days following assembly, the behaviours that were observed were more typical of normal assembled cockerels. For example, aggressive pecks were confined to the head regions, agitation ceased, frequency of pecking and fighting was greatly reduced, and a peck order evolved. Two of the 3 birds which had dominated all of the others on the day of assembly became the alpha and beta birds in the group, the third ranked in the middle of the peck order. No characteristics could be found from the data prior to assembly that distinguished the birds which were so dominating on the day of assembly.

A comparison between the normal and isolated birds in terms of their body weights, as an index of general health, indicated that the normal and isolated groups were equivalent. In addition, they were judged to be similar and in good health by professionals in poultry husbandry.

DISCUSSION

Behaviour of normal groups

Seven behaviour patterns were identified that participate in the development of the social behaviour of the domestic fowl. Four of these had been reported by Guhl (1958), although the present study cited earlier ages of occurrence than was cited by him. The discrepancy may have arisen from the use of different criteria for establishing the ages of occurrence. It is assumed that the discrepancy is not due to different criteria for judging the behaviours, since each is quite apparent and clearly differentiated from the others for a trained observer.

The stimuli which led the originating bird to make its responses were not clear. For example, if the birds were eating one might suddenly frolic. It was the impression of the observer that the response of the initiating bird was spontaneous. However, based on the observations of isolated birds, it seemed that any of a large number of sudden changes in the environment such as a noise or shadow led the originating bird to respond. It was after this original response that the other birds in the normal groups responded.

In addition to the question of the identification of the stimulus associated with the occurrences of the behaviours after they had come to high strength, is the question of the causes and/or circumstances of the first occurrence of the behaviour pattern. Although the answer to this is not clear, it can be reported as Guhl reports (1958), that the new patterns appeared rather abruptly. Continuous observation would be necessary to verify this.

The patterns which were noted in the development of the chick prior to mature social organization can be further classified into two broad categories: (1) those that occurred and then became incorporated into subsequent patterns *synthesized behaviours*; and (2) those that were maintained in their original forms but were elicited by progressively more specific stimuli, *differentiated patterns*. This classification is similar to others which have been used and are described briefly by Tinbergen (1951). Frolicking, frolicking with an object, sparring, and juvenile fighting are patterns in which each incorporated the preceding behaviour and eventually terminated in mature fighting behaviour. The synthesis into the more mature pattern did not lead immediately to the elimination of the preceding pattern. Kortlandt, as reported by Tinbergen (1951), has noted that portions of mature patterns occur early in the bird's life in a senseless manner and only later are shown in complete patterns of behaviour. This observation is consistent with the concept of synthesis as used in the context of the present study.

Generalized pecking, dominating and submitting at the food tray, and aggressive pecking and avoiding are classified as differentiated behaviours. All of these behaviours, once started, persisted in basically the same forms,

but became more and more specific in terms of the stimuli which elicited them. This was especially apparent with regard to generalized pecking in which the chicks started by pecking at many objects in their environment including many other birds. Then the responses became more specific. Dominating and submitting at the food tray also first occurred multilaterally with each bird dominating at times and submitting at others.

Behaviour development of isolated birds

The behaviour development of the isolated birds during the ten weeks of isolation showed many similarities to that of the normal birds. Each of the classes of behaviours whose definitions did not necessarily include interactions with other birds were observed to occur. These results clearly indicate that the sight of or interaction with other birds is not necessary for the development and occurrence of some social behaviours. However, the minimal conditions necessary for such development have not been established from the present study. That is, the birds in the present study were usually isolated from each other, but they could detect changes in illumination levels and sounds. A subsequent study in our laboratory in which such changes were controlled yielded similar results. Isolated birds showed the components of social responses during isolation. The responses of isolated birds in the present and subsequent studies may be vacuum responses or responses to small and usually inappropriate stimulus changes.

It is important to note that the ages of occurrence of some behaviours of the isolated groups were delayed as compared with the normal groups. Several interpretations of this delay are possible. The first is that the isolated group was delayed in biological growth due to the unusual living conditions. Comparisons of the weights and the general appearance of the normal and isolated groups argue against this interpretation. The second interpretation of the delayed occurrence of the behaviours is that inadequate stimulation was available to elicit the patterns at the earliest time in development. This may be accentuated by the fact that isolated birds were confined in an area considerably smaller than that of the normal birds.

The findings regarding social behaviours of the isolated birds after assembly are consistent with those reported by Guhl (1958). He observed a number of partially isolated birds at 9 weeks of age and reported that social organization had evolved within 3 to 8 hours after assembly. Guhl had isolated his birds when they were older than those used in the present study and they were able to see each other during the period of isolation. Fisher & Hale (1957) used partial isolation for 8 months and found that mature fighting patterns where shown within 30 minutes after assembly. Thus, the results of the present study taken in conjunction with those of the other studies, indicate that a long period of isolation may retard but does not prevent the development of social behaviours during isolation nor does it prevent

agonistic behaviour and social organization after isolation is terminated.

The behaviour pattern shown by the birds in the present study during and after isolation lend themselves to analysis in terms of synthesized and differentiated patterns and further illustrate the properties of these classes of social behaviours. With the exception of generalized pecking, which functions in a number of ways for domestic fowl, behaviours shown during isolation were synthesized behaviours that culminated in the mature fighting pattern after the birds were assembled. The appearance of these patterns in isolation is taken as evidence that they are controlled principally by internal factors and are then elicited by any of a broad range of stimuli when development is sufficiently advanced. Among the isolated group, differentiated patterns were found to differ in several respects from synthesized patterns. The differentiated patterns appeared in their mature forms among the isolated birds only after assembly. However, after assembly they occurred indiscriminately and only gradually were they controlled by specific stimuli. Thus, it was concluded that differentiation of these patterns does not occur simply as a function of maturing, but requires learning, much in the same way that changes in a bird's status in the peck order may arise from learning (Ratner, 1961).

SUMMARY

Development of social behaviour and the stimuli associated with it were studied in two separate experiments. In the first, a schedule of classes of social behaviours, ages of occurrence, and the relevant stimuli were suggested from observations of White Cobb cockerels. The results led to a six-item schedule, part of which followed work by Guhl. In the second study, two groups of White Leghorn cockerels were used. Birds in one group were isolated from one through 70 days of age; the other group were raised normally. During isolation, four patterns shown by the normal birds were shown by the isolated birds. However, systematic delay in the behaviour was noted among the isolated group. At 70 days of age the isolated birds were assembled together; immediate and intense interactions took place involving all of the birds. Full social organization was apparent within several days. It was concluded that social behaviours occurred during isolation in the absence of stimulation from other birds and that isolation does not prevent later social organization. The specific behaviours shown during development were further classified as synthesized and differentiated and this classification was applied to the present data.

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10

COMMUNICATION AND VERBAL BEHAVIOR

The stimuli involved in communication dominate human social experience. Indeed, nearly all behavioral experiences can be characterized in terms of communication. Virtually every experience involves discriminative stimuli, and discriminative stimuli provide the organism with the information necessary to obtain reinforcement. Even in nonsocial situations the environment may communicate with the organism by providing the necessary discriminative stimuli. The organism may also act on the environment to obtain the stimuli, as in the sonar used by dolphins (Bastian, 1968). However, communication is most often regarded as a social experience, usually with both or all organisms providing discriminative stimuli for one another. Verbal behavior is a particular form of communication at which human organisms excel. Verbal responses involve the abstract concept of "language," a complex of discriminative stimuli that are emitted in certain patterns. Topographically, language can be described by traditional linguistic methods. A grammar describes the patterns in which certain stimuli are likely to be emitted. Although the actual form that language takes is interesting, the behavioral approach involves primarily the study of the environmental stimuli that cause verbal responses to be emitted.

After the theory of evolution began to be accepted, a special place in nature was sought for man by distinguishing certain behaviors peculiar to man. At one time, man was thought to be the only animal who used tools. However, other primates, and even some birds, have also been found to use elements of their environments as tools. Another favorite special capacity of man is his language. Obviously, animals communicate with one another, often through very complex arrays of stimuli; however, these examples of communication are characterized as "set" and not "openended" as is language. Courting displays communicate information, but can be used only in a certain form and only in a certain situation (Armstrong, 1965). Similarly, dogs learn to respond to a variety of commands, but they are supposedly unable to extra-

polate from known commands to new ones. Each response to each command must, it is claimed, be learned independently.

Early attempts to teach chimpanzees quasi-human speech met little success (Kellogg and Kellogg, 1933; Hayes, 1951). Recently, however, Gardner and Gardner in 22 months taught a chimpanzee to use over 30 signs from the American Sign Language used by the deaf. The chimpanzee, Washoe, used these signs to name objects and situations and to make requests. Signs learned in one context transferred to others. For example, the sign for "open" was learned in connection with requests to open doors. The sign transferred to requests to open a refrigerator, drawers, briefcases, and faucets. The sign for "dog" was learned in naming pictures of dogs. The sign was later used to name the barking sound made by an unseen dog. Washoe has also formed simple combinations of signs (Gardner and Gardner, 1969). Attempts to teach chimpanzees to conform to our vocal communication system failed. The Gardners' attempt to adapt communication to the propensity of chimpanzees for motor behavior and imitation of motor responses has apparently succeeded. Man's view of animals' language as entirely inferior may be due more to man's failure to devise methods of communication with animals than to any inherent inability of animals to transfer and combine linguistic responses. Man's capacity for language may, in fact, be unique only in degree, not in its essential nature.

The best-known experimental studies of nonverbal communication in animals were done by R. E. Miller and colleagues. In one study (Miller, Banks, and Ogawa, 1962), two monkeys, seated in the same room, were placed on an avoidance schedule. Although both monkeys received shock, the response that avoided shock was available to only one monkey, and the discriminative stimulus which indicated when the response should be made was available only to the other monkey. The monkey who had access to the S^D was able to communicate sufficiently with the responding monkey to enable it to successfully make the avoidance response. Performance was good even when in one experimental session the monkey having the S^D was mistakenly not shocked. Even when a screen was placed between the monkeys, communication occurred. In a later study (Miller, Banks, and Kuwahara, 1966), two monkeys received food following the response of one monkey made during a discriminative stimulus available only to the other monkey. In this study, the responding monkey could see on a television screen only the face and head of the monkey having the S^D. The necessary communication seemed to occur in about half the pairs of monkeys. Miller feels that, in both studies, the responding monkeys used as discriminative stimuli the visible or audible emotional responses of the monkey which had the S^D. In the first case, the monkey would display the expressions and behaviors associated with anxiety. In the second case, the visible emotional responses would be those associated with reinforcement.

Dolphins have been popular subjects of attempts to understand animal communication on its own terms. A method reminiscent of Miller's has been used by Bastain (1967) to study communication in bottlenose dolphins. One member of a pair of dolphins had access to the discriminative stimuli which made possible a successful response by the second dolphin. Responses were reinforced by food for both dolphins. Apparently, auditory stimuli were used by the dolphin having the S^D to communicate with the responding dolphin. A later study (Bastian, Wall, and Anderson, unpublished manuscript) showed that this communication did not transfer to a new situation. As Bastian's work continues, however, the conditions necessary for transfer may become apparent.

Even the "openendedness" of human communication must have an origin. Some prefer to find its origin in concepts such as "the mind." However, as the reader can probably anticipate, the behavioral approach to communication finds the origin of human language and communication in experience with the environment. Of environmental stimuli, social stimuli probably are most salient in controlling verbal behavior. This chapter focuses on the relationship of verbal behavior to social stimuli.

Each person's verbal behavior probably finds its origin in the person's early experiences. The behavior of infants includes much apparently undifferentiated vocalization. Through countless experiences of reinforcement and discrimination, the vocalizations are differentiated and organized into verbal behavior which conforms to a linguistic system. The first paper presented in this chapter begins at the beginning of this process and demonstrates one mechanism whereby the vocalizations of infants can be controlled and later differentiated into speech. The paper is by P. Weisberg and is entitled "Social and nonsocial conditioning of infant vocalization." Weisberg followed the vocalizations of infants with social reinforcers commonly used in interactions between adults and infants. This reinforcement produced an increase in the rate of vocalization that was unusually resistant to extinction. After an initial period of habituation, the mere presence of the experimenter did not increase vocalization, nor did social reinforcement delivered independent of vocalization. Nonsocial reinforcement, in the form of an auditory stimulus, also did not increase the rate of vocalization. However, vocalization can undoubtedly be controlled by some nonsocial reinforcers. The nonsocial stimulus used by Weisberg was simply not reinforcing. In any case, the extreme responsiveness of rate of vocalization to social reinforcement is striking. The environment of most infants is probably rich in the sort of social reinforcers used by Weisberg. In a normal environment, these reinforcers are often given in response to infant vocalization. Relationships such as those demonstrated by Weisberg provide the clay from which human verbal behavior is fashioned.

The second study included in this chapter also demonstrates the control of verbal behavior by reinforcement. The paper, by N. J. Reynolds and T. R. Risley, is entitled "The role of social and material reinforcers in increasing talking of a disadvantaged preschool child." The subject was a child whose rate of verbal behavior was low. The child's verbal behavior was followed by social stimuli, which in turn were usually followed by material reinforcers. The reinforcement used in the study enabled the experimenter to acquire control over the child's verbal behavior. However, the content of the child's verbalizations, as well as a drop in the rate of verbalizations that received social reinforcers only, indicated that social reinforcement was relatively ineffective for this child. Ineffectiveness of social reinforcement may play an important role in many behavioral deficits. Experimental results such as Weisberg's suggest that social reinforcers are important in establishing verbal behavior. An unresponsiveness to social reinforcers, a deficiency in these reinforcers, or a noncontingent relationship between the child's vocalizations and the social reinforcement could result in verbal deficits. If social reinforcers are not established at an early age, they are unavailable for the reinforcement of early behavior, as well as other behavior. Because verbal behavior is almost always social behavior, verbal behavior may be among the most dependent on social reinforcement.

In order for any complex behavior to be established, the rate of behavior approximating it must be high. The papers by Weisberg and by Reynolds and Risley demonstrate that reinforcement produces a high rate of vocalization and verbal behavior. From the manipulation of rate during infancy, reinforcement goes on to differentiate response classes and shape the highly complex behavior known as human language. Reinforcement has been felt by some to be inadequate to explain the complexity, originality, and "open-endedness" of human language. Obviously, every word and every sentence used by an individual is not reinforced. The unreinforced and original uses of language are claimed to result from man's "mind" or "reason" or "creativity." However, without disparaging the nature of man's language and his apparent capacity for complex mental processes, environmental stimuli can be proposed as the shaping and maintaining force behind human verbal behavior. In generalization, as discussed in Chapter 4, responses not directly reinforced are maintained by reinforcement of similar responses. Differential reinforcement can be used to form these generalized responses into response classes. For example, the work of Baer and Sherman (1964) and of Peterson (1968) shows that, in imitation, responses are organized into a class on the basis of their "sameness" to a model's response. Each individual imitative response need not be reinforced as long as the class of imitative behaviors is maintained by reinforcement. Similarly, in the study of verbal behavior, Brigham and Sherman (1968) found that children reinforced for imitating English words would also imitate Russian words, the imitation of which was not reinforced.

Guess and others (1968) reinforced a severely retarded child for use of the plural in naming certain stimulus objects. Use of the plural generalized to other objects for which plural naming was never directly reinforced. Hart and Risley (1968), using the subject and the methods described in the paper by Reynolds and Risley included here, were able to reinforce, as a class of responses, the use of adjectives. Relationships of generalization and discrimination can be extremely complex, especially in the nonlaboratory environment. The complexity of these relationships could easily match the complexity of human verbal behavior. The nature of response classes is not limited by the fact that the classes are established by reinforcement. In a situation in which "humorous" responses are reinforced, the occurrence of "humorous" responses will increase. In certain groups, "creativity" may be reinforced, and verbal responses perceived as "creative" will increase. Indeed, originality is often reinforced, especially in certain segments of society. No reason exists to discount this reinforcement and attribute originality to a mysterious property of the human "mind."

The third paper presented in this chapter attempts to study an ongoing verbal interaction. The paper is by L. Simkins and J. West, and is entitled, "Reinforcement of duration of talking in triad groups." As suggested by the title, Simkins and West used groups of three individuals who were visually screened from each other. These groups were asked to discuss psychiatric case histories. Reinforcement programmed by the experimenters occurred in the form of points that were followed later by small amounts of money. Additional social reinforcers and other social stimuli were undoubtedly dispensed by the group members, but these could be neither measured nor controlled by the experimenters. The experimenter-controlled reinforcement was delivered according to several programs. The behavior of one subject in the group, known as the critical subject, was given special attention. In the first program, talking by the critical subject was simply reinforced. The second program was a mutual reinforcement relationship, similar to that studied by Boren (1966). In exchanges between the critical and noncritical subject, responses by the subject who was speaking reinforced the subject who was listening. In the third program, speaking by the critical subject reinforced the listener. The only reinforcement available to the critical subject was the nonprogrammed social reinforcement dispensed by the other subjects. In the fourth program, both the critical subject and his listeners were reinforced when the critical subject talked. The fifth program reinforced interactions between the critical and a noncritical subject as in program four, but it also punished interactions between the two noncritical subjects. The relationships studied in these programs could have involved interesting interactions. For example, in the second program, the effects of mutual reinforcement should have been apparent. The experimental arrangement allowed the addition of non-programmed discriminative stimuli which could facilitate mutual reinforce-

ment. Similarly, the third program, in which the critical subject reinforced other subjects by talking to them, could be characterized as altruistic.

The data are presented by Simkins and West in the form of means. The only clearly effective program was the fifth, which involved reinforcement of the talking critical subject, reinforcement of his listener, and punishment of interactions between the noncritical subjects. The fact that the data are, at best, suggestive is not surprising. Averaging of Boren's (1966) data would result in similar loss of information. However, the experimental method and programs devised by Simkins and West undoubtedly produced a variety of interesting relationships that, if subjected to detailed analysis, could yield valuable information on the dynamics of human verbal interactions.

The papers presented in this chapter show that the rate of vocalization and verbal behavior can be controlled by reinforcement. As mentioned previously, various studies have shown that reinforcement can control use of certain grammatical units, such as the plural morpheme and adjectives (Guess, et al., 1968; Hart and Risley, 1968). The content of verbal behavior, like the form of other behavior, can undoubtedly be controlled by reinforcement. However, in the social verbal interactions, known as conversation, which occur in the "real world," this control is mutual. Azrin and others (1961), attempting to replicate an earlier study by Verplanck (1955), tried to control the content of the verbal behavior of subjects in a situation that resembled ordinary conversation. They found that the experimenters were often unable to withhold reinforcement at appropriate times. Subjects would not tolerate absences of reinforcement. They often controlled the experimenters' verbal behavior as effectively as vice versa or would sometimes simply leave the situation. The setting of "conversation" within which Azrin et al. conducted their study was a social situation complicated by the process of mutual control among individuals. Situations in which the controlee's experience leads him to respond as if he were in a mutual reinforcement relationship tend to prevent simple control of one person by another. These situations must be analyzed as social interactions.

In other contexts, one-way control may be more readily achieved. Subjects in psychological experiments will tolerate stimuli and stimulus conditions far removed from their everyday experience (Orne and Evans, 1965). In formal experiments, lapses in reinforcement would be more likely to be tolerated. Psychotherapy is another situation in which ordinary stimulus conditions are suspended, and in which some control over the content of verbal behavior is attempted. Analyses of the psychotherapeutic relationship in terms of the reinforcement of verbal behavior have, in fact, been proposed (Krasner, 1962; Salzinger and Portnoy, 1964). The therapeutic relationship is essentially a verbal one, and some therapists characterize their behavior as designed,

first, to control the verbal behavior of the client, and, hence, to control his behavior outside the therapeutic situation. The success with which the control is achieved would depend on the skill of the therapist and also on the responsiveness of the subject to factors such as social reinforcement. An additional consideration is the fact that control of verbal behavior may be achieved without gaining any control over the other behavior that the therapeutic situation is designed to modify. Risley and Hart (1968), with 4-year-old children, reinforced verbal reports of the occurrence of a certain desirable behavior. The reinforcement produced an increase in both the rate of the verbal reporting behavior and in the rate of the actual behavior upon which the report was based. Such correspondence between verbal reports and actual behaviors will not always occur. However, in some individuals and for some behaviors, verbal stimuli emitted by the individual himself may be important in controlling that individual's own behavior. For these individuals, psychotherapy would be most beneficial, unless of course the individual was reporting and was being reinforced unwittingly for some unwanted behavior.

Psychotherapy is now widely used in an effort to control disordered behavior. However, little understanding exists of what really occurs in the psychotherapeutic situation. In addition, little evidence exists of the overall effectiveness of psychotherapy (Eysenck, 1952). Although many feel it to be a highly inefficient and sometimes totally ineffective modifier of behavior, psychotherapy will probably continue, perhaps by default, to be a major method for the treatment of behavior disorders. An understanding of psychotherapy in terms of the control of verbal behavior could make the efforts of clients and therapists more rewarding.

Verbal behavior is often regarded as the best behavioral window on "the mind." A scientific understanding of the relationship between "thought" and verbal behavior seems, at present, remote. However, on a nonscientific level, verbal behavior does seem to reflect the complexity of human intellectual behavior. Verbal behavior is an important component of "intelligence" as measured by IQ tests and by various academic standards. An understanding of the development of verbal behavior could possibly increase the "intelligence" not only of individuals presently considered to have verbal deficits, but of other individuals as well. Any useful explanation of verbal behavior will include an important role for social reinforcement. Probably the greatest portion of human social interaction occurs in the form of verbal stimuli. An understanding of human verbal interactions would not only make the control of verbal behavior more efficient in therapeutic and learning situations, but would make the understanding of human social behavior in general more comprehensive.

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Social and nonsocial conditioning of infant vocalizations

Paul Weisberg

Basic to most views on the modification of an infant's early vocalizing are the stimuli afforded by the caretaker's behavior for the control of such social behavior (3, 5, 6). Rheingold, Gewirtz, and Ross (7) found that an adult's responses contingent on the vocalizing of 3-month-old infants could bring about an increase in that behavior. Subsequently, when the reinforcing stimuli (tactual contact, "tsk" sounds, and smiles) were omitted during two days of extinction, the vocal rate declined to a level about 18 per cent above the operant rate. As Rheingold *et al.* point out, however, the question of whether vocalizing was operantly *conditioned* is equivocal since the reinforcing stimuli, per se, may have acted as social releasers. The possibility exists, then, that response-independent and dependent social events may have both stimulating and reinforcing properties for infant vocal behavior. Moreover, vocalizations may be affected by the presence in the infant's visual environment of a relatively unfamiliar and unresponding adult. That is, an immobile adult may serve as a discriminative stimulus for vocal behavior. Finally, if the infant's vocalizing effects any stimulus change in his external environment, then even such physical events (as well as social ones) might reliably strengthen the behavior.

The present investigation attempted to explore these possibilities by testing the effects of a series of short term experimental manipulations on the vocal behavior of infants.

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METHOD

Institution and environmental setting

The institution in which the experiment was conducted was an urban Catholic orphan home equipped with fairly modern facilities for the care of children ranging from 2 weeks of age through preschool age. The infants were segregated in wards according to age group. The ward of concern here housed 16 infants of both sexes, with a median age of 3 months. The infants were multiply cared for by full time attendants, by resident "foster mothers," and occasionally by volunteers, but usually one attendant was left in charge of the 16 infants.

Subjects

Thirty-three 3-month-old full term infants, diagnosed as physically healthy, served as *S*s. The groups to which the *S*s were assigned (to be described below) did not differ significantly on such variables as age, birth weight, pre-experimental weight, and length of time in the institution. The ratio of males to females for each group varied from 5:1 to 3:3.

Procedure

The experiment took place in a small storage room relatively free from distraction by other infants or by the personnel of the orphanage. None of the infants had ever been in this room prior to the experiment. Once an *S* was ready for testing, that *S* was carried by *E* to the experimental room and seated in a canvas swing (Swyngomatic). *E* then concealed himself behind a partition in this room and waited 30 sec. before beginning an experimental session. If, within this time an *S* fell asleep, started to cry or to protest persistently, he was carried back to his crib and another session was attempted after half an hour had elapsed. Two 10-min. sessions were planned daily, but a session was terminated before the full 10 minutes had expired if any of these petulant behaviors appeared during the first 6 min. of a session. Thus every session reported lasted more than 6 min. without a prolonged disturbance by *S*. (76 per cent of all sessions ran the full 10 min.) If an *S* failed to complete two full daily sessions for one reason or another, that *S* was withdrawn from the experiment; five *S*s were dropped following this criterion.

Each response consisted of a "discrete, voiced sound produced by *S*" (7, p. 69) appearing within each respiratory unit. Sounds classified as either "emotional" (protests, crying) or reflexive (coughs, sneezes, and certain digestive outbursts) were excluded. The phonetic topography of the response was not analyzed; the dependent variable was frequency of vocalizations

made per min., i.e., rate of responding. Vocalizations and stimulus events were recorded on a kymograph. The recording speed was set at half an in. per sec., and each event could be marked by *E*'s depression and release of a silent microswitch which was hidden from *S*. The median interobserver agreement on 20 sessions between *E* and another person trained to discriminate vocal behavior was 97 per cent (range 67 to 100 per cent). The rank-order correlation between the mean rates of both observers was ·99.

Vocalizations of members of six groups were recorded through eight consecutive days. Either five or six *S*s were randomly assigned to each group as they became available; if an *S* could not complete the experiment, he was replaced by the first available *S*. The experimental conditions of the fifth and sixth days were the basis for naming the groups. They were: No *E* present; *E* present; Noncontingent social stimulation; Noncontingent non-social stimulation; Contingent social stimulation; and Contingent nonsocial stimulation. These conditions include all that appeared in any part of the experiment. After describing them, the sequences appropriate to each group, each day, will be stated, providing the full experimental procedure.

1. *No E present.* The experimenter (*E*) remained behind a partition located about 5 ft. to the left of *S*. The upper part of the partition was transparent and allowed the *E* to observe all of *S*'s behavior. *E* stationed himself at an angle which was about 135° from *S*'s foveal line of vision so that, if *S* turned his head to the left, the chances of seeing *E* were minimized. *E*, of course, minimized any auditory or movement cues that might indicate his presence. Under these conditions *S* oriented towards objects directly in front of himself (including parts of his body) and only occasionally turned to the left or right. *S*'s body size and the construction of the swing prevented him from making large torso movements.

2. *E present.* *E* seated himself facing *S* approximately 2 ft. away. *E* never smiled, frowned, or made rapid jerky movements of the head while in *S*'s presence; he did not open his mouth and maintained a "blank expression" fixating in the vicinity of *S*'s face. To keep his facial appearance invariant, *E* covertly counted numbers while fixating upon *S*.

3. *Noncontingent social stimulation.* *S*s received stimulation on a prearranged schedule from *E* who was seated before them. The stimulation consisted of rubbing *S*'s chin with the thumb and forefinger followed and overlapped by an open-mouthed "toothy" smile and an aspirated "yeah" sound. Each such event lasted for about 2 sec. These events were given randomly four times a min. with the restriction that the interval between one event and the onset of the next be greater than 7 sec. On occasions when social stimulation was not given, *E* reverted to the facial expression described during the "*E* present" condition.

4. *Noncontingent nonsocial stimulation.* A door chime sounded on the same schedule as that followed with noncontingent social stimulation while E was seated faced toward S. Through successive sessions, the chime sounded 3 ft. to the left or right of S in an ABBA sequence.

5. *Contingent social stimulation.* The conditioning operations were performed by presenting the social stimulation described above immediately for each vocalization; that is, the smiles and the like were given contingent upon the infant's vocalizing. Responses made during the presentation of social stimulation were not further reinforced, and, during periods when S did not vocalize, E maintained the "blank expression."

6. *Contingent nonsocial stimulation.* The chime was sounded by E who was seated facing S immediately after each response. Vocalizations appearing during the chime's duration did not produce further auditory consequences. Spatial location of the chime also varied in an ABBA fashion from one session to the next.

The sequences through which the various Ss were run are presented in Table 10-1.

Table 10-1. Experimental design

Group	Days: 1 and 2	3 and 4	5 and 6	7 and 8
I (N=6)	No E	No E	No E	No E
II (N=5)	No E	E present	E present	E present
III (N=5)	No E	E present	Noncontingent social stimulation	Noncontingent social stimulation
IV (N=6)	No E	E present	Noncontingent nonsocial stimulation	Noncontingent nonsocial stimulation
V (N=5)	No E	E present	Contingent social stimulation	Extinction (E present)
VI (N=6)	No E	E present	Contingent nonsocial stimulation	Extinction (E present)

Group I controlled for changes in the operant rate of vocalizing with time in the experiment independent of an E being present. Group II served as a second control group, and any differences between the rates of groups I and II would indicate whether the presence of a human acted as an S^D for vocalizations. Groups III and IV were used to determine whether the reinforcing stimuli had eliciting properties and hence to clarify whether any changes in rates observed in groups V and VI could be attributed to reinforcement (namely, social and nonsocial stimulation, respectively), *contingent*

upon the occurrence of a response. Groups V and VI were used to show whether the rates of vocalizing shifted upward and downward by the imposition of reinforcement contingencies, and thus whether the behavior could be operantly conditioned.

RESULTS

Control day analysis (days 1 to 4)

An analysis of variance of *S*'s mean vocalization rates for days 1 to 4 (group variances as determined by the Bartlett test were homogeneous; uncorrected $\chi^2 = 10.65$; $p > .05$ with 5 *df*) revealed a significant day effect only ($F = 7.09$; $p < .001$ for 3 and 81 *df*). Further analysis of this day effect by *t* tests for correlated means based on all groups showed that the mean rates for each of the last three days were reliably greater than those of day 1 (all p's $< .02$). Days 2, 3, and 4 (means = .91, 1.13, and 1.21, respectively) were not significantly different from one another. The increase in rate after the low day 1 rates (mean = .54) probably indicate habituation of initial response to the relatively novel stimuli in the infant's environment. The day 2 rates provide good measures of the infant's vocal behavior when a human is absent from his environment, since the mean for all *S*s on day 2 are close to the mean of the daily rates for just group 1 (*No E*) on subsequent days of the experiment (means = .91 and 1.00, respectively). Absence of an initial selection bias is suggested by the lack of any significant group differences on these control days and the fact that the days did not discriminate among the groups.

Effect of *E*

Upon the first introduction of *E* on day 3, 17 out of 27 *S*s in groups II to VI (inclusive) increased in their rate over day 2 (binomial test = 1.15; $p = .25$, two-tailed test). The median gain for these 17 *S*s was about the same for the 10 *S*s who dropped in rate (medians = + .40 and − .37, respectively). By day 4, nine out of the 17 *S*s whose rates were augmented on day 3 had declined in rate. The changes in mean rate of the six *S*s in group I (*No E*) over this same time span were as follows: three *S*s increased, one *S* decreased, and two *S*s did not change in rate during days 2 to 3; four *S*s increased and two *S*s decreased in rate during days 3 to 4. Thus the presence relative to the absence of an unresponsive, immobile adult in the infant's visual environment is evidently not a releaser or discriminative stimulus for vocalizations.

Treatment effects

The mean rates of days 3 and 4, 5 and 6, and 7 and 8 are plotted in Figure 10-1. (Pairs of treatment days were combined since each of these within-

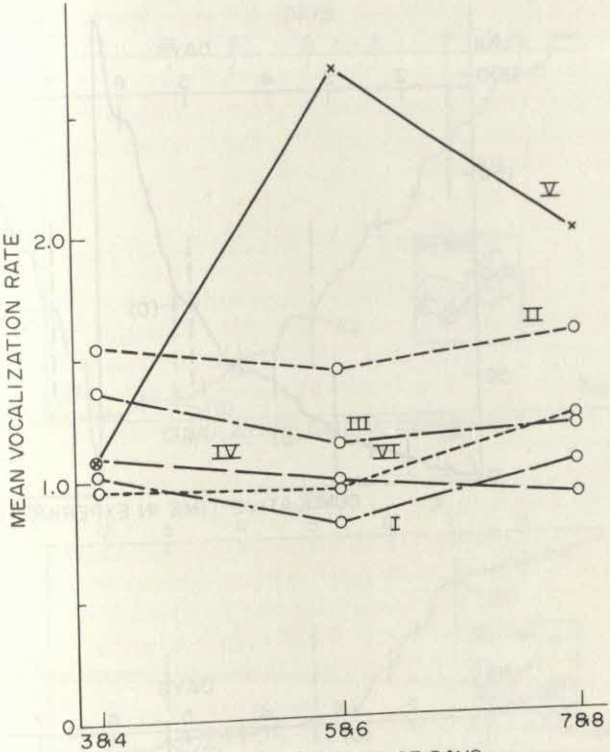

Figure 10–1. Group mean vocalization rates during the procedure of days 3 and 4, 5 and 6, and 7 and 8. (*See* Table 10–1 for procedure.)

group day effects were not significantly different from each other.) Treating the different groups as blocks and any particular set of days as columns with the *Ss*' mean response rate as row observations, the data lent themselves to a pseudo-three way analysis of variance design (4, p. 332). The analysis of the mean rates for each *S* on the control sessions (days 3 and 4) and experimental sessions (days 5 and 6) did not indicate any reliable differences either between these combined sets of days ($F = 1.63; p > .20$ for 1 and 27 *df*) or between groups ($F = 1.14; p > .20$ for 5 and 27 *df*). There was, however, a significant day × group interaction ($F = 4.94; p < .01$ for 5 and 27 *df*). The fact that all the *Ss* in group V showed considerable gains in their vocal rates between these two time spans indicates that social stimulation contingent on the infant's vocalizing acted to reinforce that behavior. However, when the chime was made contingent on vocalization (i.e., group VI), the overall rate for this group as well as groups I-IV remained fairly stable. When a similar analysis was performed for days 5 and 6 and days 7 and 8, there were

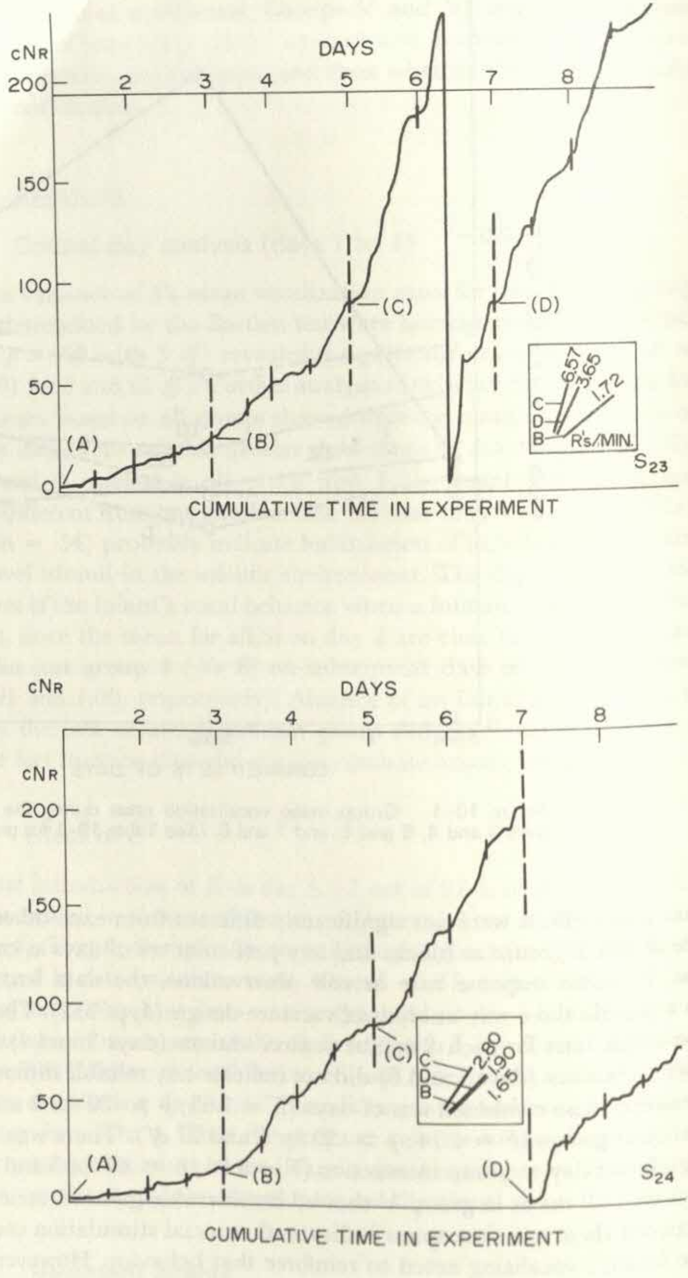

Figure 10-2. Cumulative number of responses for group V *S*s as a function of time in the experiment (in min.). (a) No *E*; (b) *E* present; (c) Contingent social stimulation; (d) Extinction. Short vertical lines separate sessions.

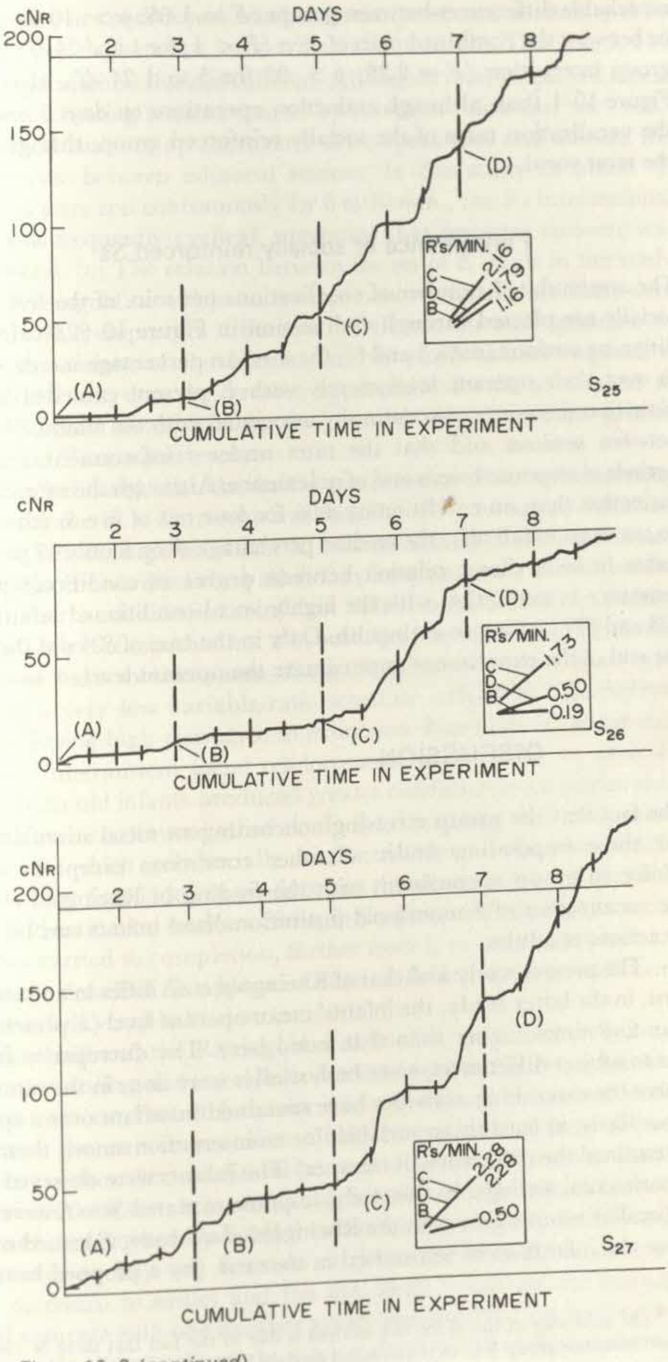

Figure 10-2 (*continued*)

no reliable differences between groups ($F = 1.65$; $p > .10$ for 5 and 24 *df*),[1] or between the combined pairs of days ($F < 1$; for 1 and 24 *df*) and the day × group interaction ($F = 2.38$; $p > .05$ for 5 and 24 *df*). However, note in Figure 10-1 that, although extinction operations on days 7 and 8 decreased the vocalization rates of the socially reinforced group, that group remained the most vocal.

Performance of socially reinforced *S*s

The accumulated number of vocalizations per min. of the five *S*s reinforced socially are plotted through each session in Figure 10-2. During social conditioning sessions (days 5 and 6), the median percentage increase based on all *S*s over their operant level merely with *E* present exceeded 282 per cent. Note that there is no discontinuity associated with the almost 24 hour periods between sessions and that the rates under reinforcement are marked by periods of response bursts and of quiescence. Although the rates were lower on extinction than on conditioning days for four out of five *S*s (the rates for *S*27 do not seem to fall off), the median percentage drop is only 47 per cent. There seems to be a direct relation between degree of conditioning success and resistance to extinction with the highly vocal-conditioned infants (especially *S*23 and *S*27) failing to extinguish. Only in the case of *S*24 did the rate toward the end of the experiment approximate the operant level.

DISCUSSION

The fact that the group receiving noncontingent social stimulation behaved like those responding under all other conditions except for the socially reinforced group is consistent with the finding of Rheingold *et al.* (7) that the vocalization of 3-month-old institutionalized infants can be conditioned by actions of adults.

The present study and that of Rheingold *et al.* differ in a number of ways. First, in the latter study, the infants' mean operant level (*E* present) was more than four times higher than that found here. The discrepancy is least likely due to subject differences, since both studies were done in the same institution where the caretaking activities have remained invariant over a span of years. More likely, at least three variables (or an interaction among them) may have determined the difference in rates: (a) The infants were observed in different experimental settings. In this study, response of seated *S*s to *E* were made in an unfamiliar room whereas in the Rheingold *et al.* study, *E* leaned over *S*'s crib. Since the infants were self-nursed in *their crib* (by a propped bottle arrange-

[1] The reduction of the *df* for this analysis is due to the fact that three *S*s (one from group IV and two from group VI) were not tested on days 7 and 8.

ment), a secondary or conditioned reinforcement (or even a secondary drive stimulus reduction) explanation cannot be ruled out. (b) The length and continuity of experimental sessions differed. Rheingold *et al.* employed blocks of three three-min. testing sessions spaced by two-min. "time out" or "rest" periods; this could have set up short term drive operations and allowed the response to recover between adjacent sessions. In this study in which "*E* present" sessions were run continuously for 6 to 10 min., the *S*'s intrasessional response rate was frequently cyclical, suggesting that response recovery was an ongoing process. (c) The relation between the sex of *E* (male in this study and female in Rheingold's *et al.*) in an environment where all caretakers were female is a potentially important difference. While one can only speculate on the unknown dimensions of the human face to which infants respond, it should be pointed out that the greater opportunity for *S*s to respond to "female"-like stimuli (faces, voices, etc.) would thus introduce greater "novelty" of *E* on *S*'s operant level.

The results indicated that the initial presentation of an unresponding human did not serve as a discriminative stimulus (S^D) for vocal behavior. However, the relatively high resistance to extinction rates of the conditioned group suggest that the unresponding adult may have become a discriminative stimulus or, at least, a conditioned reinforcer. Admittedly, the high extinction rates could be due to the fact that not all vocalizing responses were reinforced on a continuous basis so that some of the *S*'s responses could have been conditioned on a very low variable-ratio schedule (effectively, an interval one), thus developing high resistance to extinction. Brackbill (1) found that several values of intermittent social reinforcement provided by an adult for smiling in 4-month-old infants produced greater resistance to extinction than that resulting from a continuous schedule. In the Rheingold *et al.* study, however, vocalizations which were socially reinforced either on the average of 72 or 94 per cent of the time failed to produce any differential effect both during conditioning and extinction sessions. Since, in the present study the extinction process was not carried to completion, further work is necessary before it can be shown that the details of *E*'s appearance can as stimuli become conditioned reinforcers for infant vocal behavior.

In the Brackbill and the Rheingold *et al.* studies, an inverse relation of protest (crying) to smiling and vocal behavior was found between conditioning and extinction sessions. Protest behavior was not directly measured in this study. However, the extinction sessions did not need to be terminated any earlier than any of the other conditions because of persistent protests. During extinction sessions there was, however, a change in the topography of the vocal response. After being emitted by *S* and then not reinforced by *E*, the full social response sequence on any one occasion might abruptly shift to pouts and whines only to return to smiles and the like. Both behaviors are mutually exclusive and compete with one another across time, so that, if extinction had been extended the "protest" might have gained in strength, eventually

causing E to terminate the session and take the infant out of the situation. Substantiating evidence for this view is reported by Brackbill whose infants, after being extinguished to their operant level and below, refused to fixate to her face—"an occurrence, . . . that was in distinct contrast to *S*'s persistent fixation during conditioning" (1, p. 120). The relation between "positive" and "negative" kinds of social behavior may be understood in terms of Estes' (2) finding that the conditioning of one behavior is a function of the initial strength of all behaviors and of the concurrent extinction of competing reactions.

There remains the question of the unsuccessful attempts to condition vocalizing using a nonsocial stimulus as a reinforcer. Since the noncontingent and contingent nonsocial *S*s oriented towards the chime during its inital presentation, it is unlikely that the stimulus was not discriminated. The possibility exists that presenting the chime in the presence of an unresponding adult might facilitate habituation of responses to it. A test of this supposition would be to compare the effects of the chime as either an evoking or reinforcing stimulus when it is given either in the absence or presence of an adult.

The results of this study should not be taken to mean that nonsocial stimuli are necessarily inconsequential for the prediction and control of infant social behavior. These data show only that the particular chime used, under these conditions, in infants of this age, was ineffective. Rheingold *et al.*, (8), Simmons (9), and Simmons and Lipsitt (10) have used nonsocial stimuli (lights and chimes) for the maintenance of behavior in older infants. The range of stimuli and subjects investigated must be extended.

SUMMARY

The vocal behavior of institutionalized 3-month-old infants in relation to manipulations in their physical and social environment through eight consecutive days was explored.

The results indicated that, after habituating to an unfamiliar setting devoid of humans, the *S*'s rate of vocalizing did not reliably increase when an unresponding adult was introduced and made part of this environment, i.e., the immobile adult was evidently not a social releaser or S^D for vocal behavior. Taking the vocalizing rate in the presence of the unresponsive adult as the operant level, it was found that the behavior could be operantly conditioned by social consequences (the adult briefly touched *S*'s chin and simultaneously smiled at and "talked" to him). Extinction operations subsequently reduced the rate but not to baseline performance. Conditions other than social reinforcement (e.g., presenting the reinforcing stimulus noncontingent upon vocalizing and giving an auditory stimulus in the presence of an unresponding adult both independently of and contingent upon vocalizing) did not seem to control infant vocal behavior.

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The role of social and material reinforcers in increasing talking of a disadvantaged preschool child

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and
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Children in an economically deprived area lack many skills which would enable them to function effectively in the public schools or in the middle-class society, of which public schools are an integral part. The most damaging deficiency appears to be a lack of verbal and language skills (Bereiter and Engelmann, 1966), whereby the child learns what the school has to teach and communicates what he has, or has not, learned. Consequently, most people interested in remediating the effects of cultural deprivation are concerned with increasing the language skills of these children. In view of this concern with the value of verbal skills for economically deprived children, it was felt that an especially low frequency of verbal behavior by one such preschool child should be altered. Previous studies utilizing operant conditioning procedures have demonstrated how a manipulation of this nature could be undertaken. The pioneering studies from the University of Washington Preschool have investigated the applicability of operant principles to changing the problem behavior of normal children in naturally occurring situations (summarized in Harris, Wolf, and Baer, 1964). These studies, which investigated the relationship between the behaviors of teachers and the behaviors of preschool children, have indicated that the "attention" of the teacher can function as a strong reinforcer to establish, modify, and maintain the behavior of preschool children.

This development has provided information about principles of behavior and how these principles affect human behavior. It has also provided a technology for therapeutic intervention in human problems and for increasingly more sophisticated analyses of human behavior. The present study

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was undertaken to increase the frequency of verbalization of a child in a preschool setting and subsequently to analyze the controlling components of the teacher-child interaction in producing the behavior increase, as well as to assess some of the changes in the content of verbalizations in relation to changes in the frequency of verbalizations.

METHOD

Subject and setting

The study was conducted at the Turner House preschool of the Juniper Gardens Children's Project in Kansas City, Kansas. The subject was a 4-yr-old girl who exhibited a low frequency of verbal behavior well after the period considered normal for adaptation to the preschool routine and setting. She was one of 15 children, all Negroes from a lower class community, selected from large families with extremely low incomes. The subject's Peabody Picture Vocabulary Test I.Q. was 59, slightly below the average (79) of the group, but she did not appear retarded. She gave appropriate answers in structured teaching situations if the teachers could get her to speak loud enough to be heard. She was particularly skilled in motor activities, and despite her non-verbal method of obtaining play materials from other children ("grabbing"), appeared well-liked by the other children.

The preschool ran from 8:30 to 11:30 a.m. five days a week. During the first 45 min of the morning, special training programs and individual tasks for the children were combined with breakfast. The remainder of the morning consisted of an approximately 45-min period of free play inside, a 30-min snack and instruction time, a 45-min period of free play outside, and a story time inside just before going home.

During free-play periods, the children could move from one to another of the unstructured activities usually found in preschool programs such as a block area, a doll area, a painting area, or a sand box. Some materials such as blocks were available to the children, and others such as paint were dispensed by the teachers. During the free-play periods, the three teachers always attended to, talked to, and interacted with the children and occasionally provided snacks (fruit, cookies, crackers, *etc.*) contingent upon generally appropriate play behavior.

PROCEDURES AND RESULTS

Recording

Three observers recorded data during the morning free-play periods, and although present in the preschool room and yard with the children, did not interact with or respond to them. Observations of the subject were made at

sample intervals only during free-play periods. During these periods the child's speech was sampled using two different recording procedures, one recording how often she spoke and one recording what she said.

Frequency of verbalization. Verbal frequency data were collected simultaneously by all three observers. They carried data sheets similar to those described by Allen, Hart, Buell, Harris, and Wolf (1964) and Hall, Lund, and Jackson (1968). Each row of the data sheet contained 30 squares representing a 10-sec interval per square, or 5 min per row. Two adjacent rows were used for each 5-min observation. The top row was used to record talking or verbalization by the child. Whenever the child verbalized during a 10-sec interval a (T) was written in the square corresponding to that interval. Only one (T) marked in any interval during which the child verbalized irrespective of the amount of talking that occurred in that 10-sec period. If the child's verbalization began in one 10-sec interval and extended into the next, a (T)

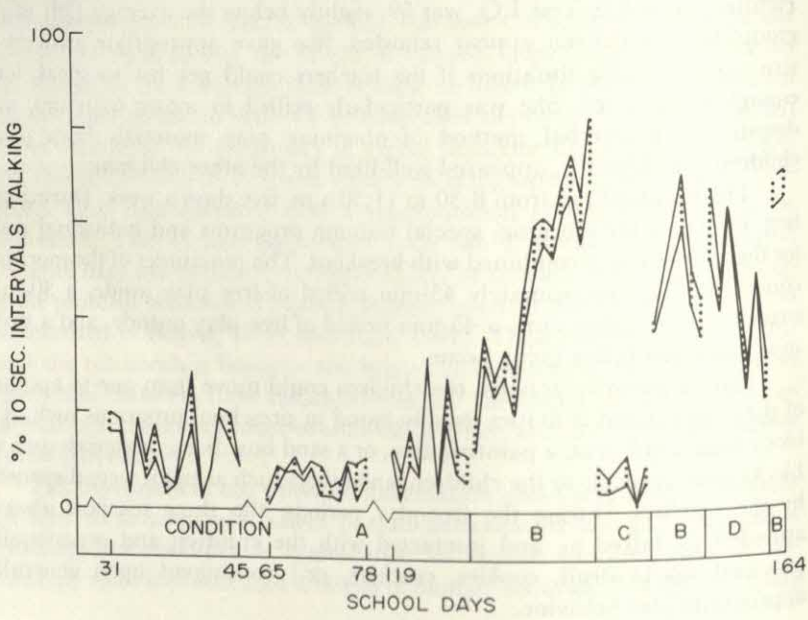

Figure 10-3. The per cent of 10-sec intervals during which talking occurred. The experimental conditions were: (A) Baseline. (B) Teacher attention contingent upon any verbalization. (Social interaction immediately contingent upon all verbalizations; access to materials contingent upon responding to variable number of questions whenever verbalizations were requests for materials.) (C) Teacher attention contingent upon silence (DRO). (D) Teacher attention contingent upon any verbalization (Social interaction immediately contingent upon all verbalizations; materials immediately contingent upon requests). The two lines on the graph represent the highest and lowest scores of the three observers. The dots in the lower portion of the graph mark those days when observations were made by only two observers.

was noted in both intervals. Frequency of verbalization was therefore recorded as the per cent of 10-sec intervals of the sample during which verbalization occurred. The bottom row was used to record teacher attention by placing the initial of the attending teacher in the square corresponding to the 10-sec interval in which teacher attention occurred. Teacher attention was counted in the same way as verbalizations by the child.

Starting at the same time, using stopwatches, the three observers simultaneously but independently recorded the frequency of the child's verbalizations for 5-min periods. Usually, three such 5-min samples were taken each day during the two free-play periods: two during the first free-play period and one during the second, although occasionally only one or two 5-min samples were taken during a day.

Verbalizations were defined as any speech from the child heard by the observers, except random noises such as shrieking, humming, or laughing. During rate samples, speech which was too low for the observers to understand fully was counted, though this was not true of the content samples. Teacher attention was counted as any time a teacher spoke to, gave equipment to, or touched the child.

The correspondence between the three observers' data on frequency of verbalization is shown in Figure 10-3, where the top line represents the highest rate and the bottom line the lowest rate obtained by an observer on a given sample. The product-moment correlation coefficients between the frequency data of the three observers on all observations throughout the year were:

0.97 for observers A and B (64 samples)
0.96 for observers A and C (59 samples)
0.99 for observers B and C (59 samples).

The product-moment correlation coefficients between the teacher attention data over the same samples were:

0.85 for observers A and B (64 samples)
0.90 for observers A and C (59 samples)
0.97 for observers B and C (59 samples).

Content of verbalization. The content of verbalization samples were collected over the same portions of the year as the frequency of verbalization samples, but not necessarily on the same days. The verbal content samples were recorded during free play by one of three observers, who wrote down in longhand "everything" that the child said while following her from one activity to another during a 15-min period. Twenty-nine such samples were taken on different days during the baseline condition (Days 1 to 29), 7 by observer A, 13 by observer B, and 9 by observer C. During the experimental conditions (Days 130 to 164) observer A recorded all 30 verbal content samples, with observer B simultaneously recording on two occasions (Days 157 and 162). These verbalization records were then transcribed and content

was categorized and counted from the transcribed phrases by one teacher. As observers recorded the data, they also put a check in one column if the verbalization was directed toward a child, and a check in a second column if it was directed toward a teacher (immediately following a recorded verbalization). General grammatical rules were used to categorize roughly the content of the verbalizations. As the nouns and verbs were counted, the first appearance of a noun or a verb was added to the count of *different* nouns and verbs. Each subsequent time the child said that noun or verb in the same content sample, it was counted as a repetition. The phrases were also defined as sentences if they included a subject (or implied subject) and a verb. These sentences were then categorized as *mand*, generally a request, demand, or question which specified the reinforcer (Skinner, 1957), or *non-mand* sentences. Sixteen of these verbalization records (randomly selected but including at least two from each condition) were independently categorized and counted by the second teacher.

Table 10–2. Comparison between the three observers' records of the content of the child's speech during baseline (average frequency per sample)

	Observer		
	A	B	C
Nouns and Verbs:			
Total	10.0	8.6	12.3
Different	4.6	5.5	6.9
Verbalizations:			
To teacher	3.8	2.8	5.3
To child	4.8	11.0	5.8
Verbalizations:			
Mands	6.6	3.6	5.4
Non-mands	0.02	3.4	1.0

The averages of the content measures from each observer's records during the baseline period are compared in Table 10–2. The correspondence between the measures taken from the three observer's records indicates the reliability of the low frequencies of the content measures between different observers on different days. On the two occasions of simultaneous recording, observer A recorded 12 different nouns and verbs with 37 repetitions and observer B recorded 11 different and 22 repetitions on Day 157; observer A recorded 16 different and 58 repetitions and observer B recorded 14 different and 43 repetitions on Day 162. On the 16 samples categorized by the second teacher, the product-moment correlation coefficients between the scores of the two raters were 0.99 for nouns and verbs, and *mand* sentences and 0.95 for *non-mand* sentences.

Experimental conditions

The following contingencies and experimental manipulations were in effect throughout the entire free-play periods, which usually totaled close to 1.5 hr each day:

A.	Baseline.	(Days 1 to 129)
B.	Teacher attention contingent on verbalization.	(Days 130 to 142)
C.	Teacher attention contingent on non-verbalization; differential reinforcement of other behavior (DRO).	(Days 143 to 148)
B.	Teacher attention contingent on verbalization.	(Days 149 to 154)
D.	Modified teacher attention contingent on verbalization.	(Days 155 to 161)
B.	Teacher attention contingent on verbalization.	(Days 162 to 163)

A. Baseline. During the first 129 days that the child was in school, verbalizations occurred during an average of 11% of the 10-sec intervals of each sample, ranging between 1% and 32% on individual samples. Teacher attention during that time ranged between 0% and 36% with an average of 11%. Data between Days 31 to 45, 65 to 78, and 119 to 129 are shown in Condition A of Fig. 10-3.

B. Teacher attention contingent upon verbalization. From Day 130 through 142, the teachers' attention to the child was contingent upon her verbalizations and was maintained while she was talking. Teacher attention consisted of a variety of stimuli which included one or more of the following: praising the child, asking her questions, giving her equipment, assisting her, attending to, talking to, and providing a requested object or material. The form of the teacher attention varied according to the context of the child's verbalizations and the nature of the situation. However, whenever the child's verbalization was in the form of a request for materials, the teacher would ask questions about the materials or the child's projected use of the materials. The material itself would only be given contingent upon the child's responding to one or more such questions. For example, if the child said that she wanted to paint, the teacher would praise her for saying what she wanted, and then ask her what she was going to paint or what other things she needed in order to paint, *e.g.*, brush, paper. Again they praised her for any verbal responses she made and perhaps asked her another question. This was continued as long as the teacher could ask reasonable or logical questions concerning the situation; it usually ranged between one and three questions per request for materials, though occasionally no questions were asked. Thus, while teacher attention in the form of social interaction was given contingent upon each instance of verbalization, whenever the verbalization was a request for materials,

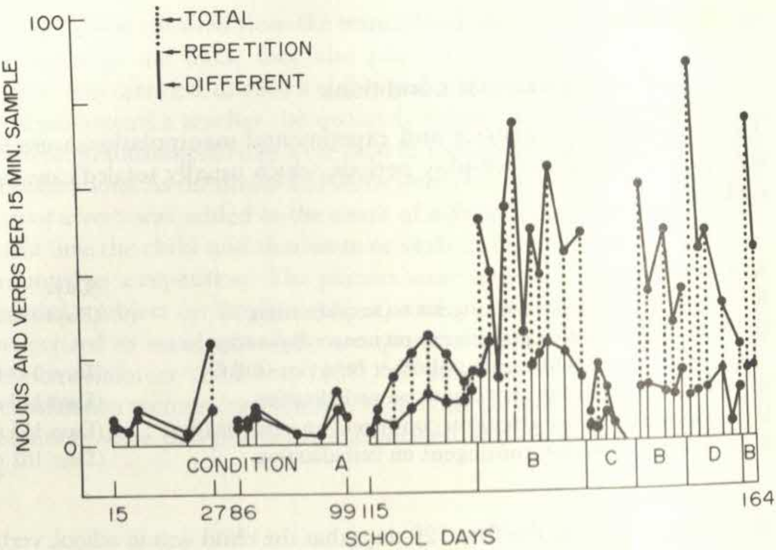

Figure 10–4. Frequency of nouns and verbs during periodic recording of the child's speech. The conditions correspond to the conditions described in Figure 10–3.

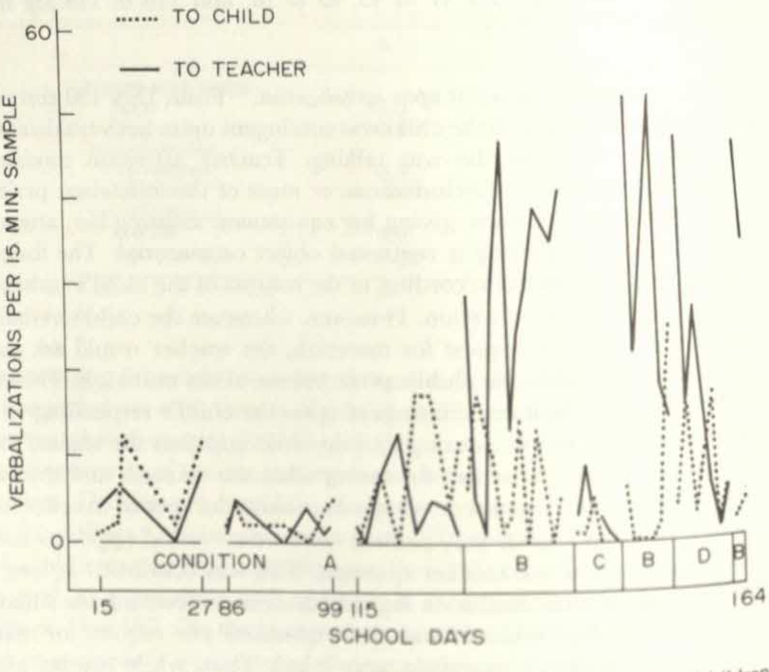

Figure 10–5. Frequency of statements to teachers and to other children during recording of the child's speech. The conditions correspond to the conditions described in Figure 10–3.

teachers' interactions were in the form of asking questions about the materials and the materials were dispensed on a small variable ratio for answering questions. When possible, teachers required the child to ask for materials by preventing her free access to them.

During the 13 days of these conditions, the frequency of the child's verbalization increased from 11% to 75% of the 10-sec intervals (Condition B, Fig. 10–3). The number of nouns and verbs used increased from an average of 15 (range 3 to 25) to an average of 46 (range 14 to 73) per 15-min content sample. The number of different nouns and verbs used per sample increased from an average of seven to an average of 16 while the frequency of repetitions increased nearly twice as much from an average of seven to an average of 30 (Condition B, Fig. 10–4).

The number of verbalizations directed to a child remained approximately constant (changing from an average of 7.6 to 7.9) while the number of verbalizations directed to a teacher increased from an average of 4.2 to 26.8 during this period (Condition B, Fig. 10–5). The number of *non-mand* sentences remained approximately constant (changing from an average of 2.3 to 2.6) while the number of *mand* sentences increased from an average of 4.2 to 19.5 during this period (Condition B, Fig. 10–6).

In summary, the marked increases in frequency of verbalizations were almost entirely a function of an increase in the frequency of requests (*mands*) to the teacher (usually for materials). These increased requests involved the use of a slightly greater vocabulary than before but a proportionately greater increase in repetitions of the same words.

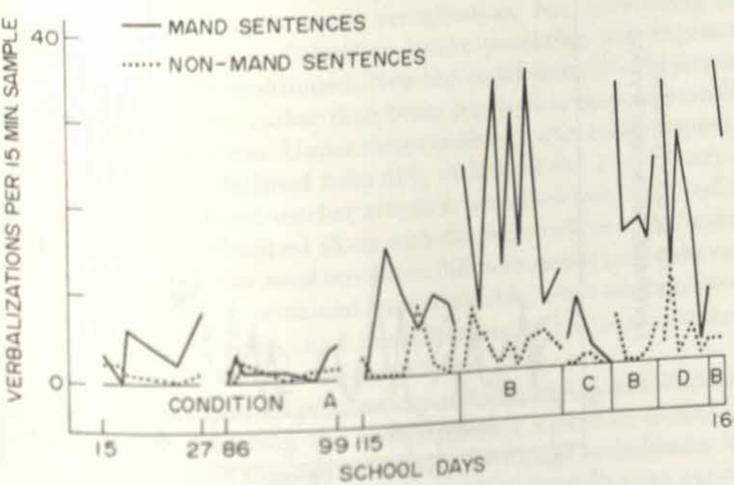

Figure 10–6. Frequency of *mand* and *non-mand* sentences during periodic recordings of the child's speech. The conditions correspond to the conditions described in Figure 10–3.

C. Teacher attention contingent on non-verbalization (DRO). Since the frequency of teacher attention was now higher, it became necessary to investigate whether the increased instance of teacher attention, *per se*, or the contingency of presenting teacher attention immediately after the child verbalized was maintaining the verbal rate. It might be said that the child verbalized at a higher frequency simply because the teachers were attending and talking to her more, indicating that the higher incidence of teacher attention rather than its contingency of following the child's verbalizations was maintaining this frequency. Therefore, the teacher attention was maintined at as high a rate but was now made contingent upon non-verbalization by the child. Typically the teachers would attend to the child, praising her and providing her with materials while she was silently engaged in activities. For example, if the children near the child were asking for water and she picked up a cup, the teacher would reinforce the child's behavior of not asking by pouring water into her cup and keeping it filled as long as she was silent, and praising her for pouring from her cup, working hard, and keeping busy. The teachers removed their attention and the supplying source of materials for 15 to 30 sec immediately following a verbalization by the child. (This procedure is often described as differential reinforcement of other behaviors, [DRO], since teacher attention is presented contingent upon any behavior except the behavior being measured, in this case talking.)

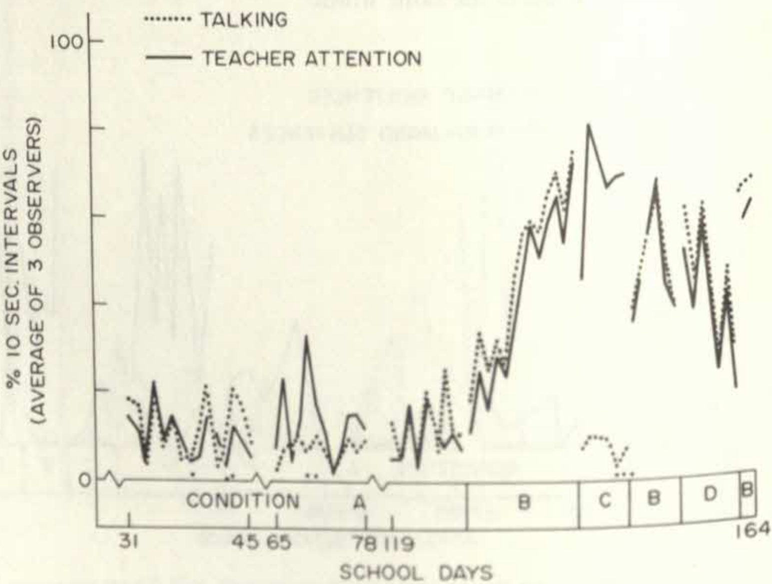

Figure 10-7. The relationship between teacher attention and talking by the child. The conditions correspond to those described in Figure 10-3.

During six days of DRO, the rate of verbalization dropped from an average of 46% to 6% while the rate of teacher attention was maintained at an average of 67% (Condition C, Figs. 10-3 and 10-7). At this point, teacher attention was again given contingent upon verbalization by the child. Her frequency of verbalization immediately increased to an average of 51% during the four days of this condition, while the rate of teacher attention averaged 47% (Condition D, Figs. 10-3 and 10-7).

During DRO, several aspects of the child's verbal content dropped well below the baseline level. The number of total nouns and verbs used dropped to an average of four per day. The amount of talking decreased to the point that little verbalization was made to either teachers or children, though the amount of talking to teachers was higher at an average of three per day, but only one per day to children.

D. Modified teacher attention contingent on verbalizations. The DRO condition demonstrated the function of the gross category of teacher attention in maintaining the child's increased rate of verbalization. However, the analysis of the content of the verbalizations, which revealed that the increase was primarily in repeated requests to the teachers for materials, indicated that the praise and social interaction components of the teachers' attention might not be functional. Therefore, a further manipulation was made to analyze experimentally the functions of the two components of teacher attention: the teachers' praise and social interaction, and the teachers' questioning the child and requiring additional verbalizations before providing a requested material.

After recovery from DRO, for six days social interaction with the teacher remained exclusively contingent upon verbalization, but questioning the child and requiring further verbalization before providing any requested material to the child was discontinued. Now she could immediately acquire materials by asking for them, rather than being required to respond verbally to questions in order to get them. Under these conditions, the child's frequency of verbalization gradually declined from 61% to 28% of the 10-sec intervals (Condition D, Fig 10-3). Since teacher attention was given only after verbalization by the child, it too dropped along with the frequency of verbalization (Condition D, Fig. 10-7). *Non-mand* sentences, different nouns and verbs used and verbalizations to children remained relatively stable, while *mand* sentences, repetitions of nouns and verbs, and verbalizations to teachers decreased systematically (Condition D, Figs. 10-4, 10-5, and 10-6).

When the teachers again asked questions and required several responses from the child before providing her with requested materials during the following two days (the final two days of school), the rate of verbalization immediately increased from 29% on the last day of Condition D to an average of 67% (Fig. 10-3 and 10-7). The number of repetitions of nouns and verbs, verbalizations to teachers, and *mands* all increased to a level comparable to

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Reinforcement of duration of talking in triad groups

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Within the past several years there have been several investigators (Cieutat, 1959; Oakes, Droge, & August, 1960) who have attempted to extend the operant conditioning paradigm to the study of verbal behavior in small groups. Using procedures similar to those employed in our investigation, Bavelas, Hastorf, Gross, and Kite (1965) showed that changes in duration of talking by members composing their groups could be manipulated by using a combination of reinforcement and punishment contingencies. An intere finding was that changes in duration of talking were also accompanie changes in sociometric rankings. As the duration of talking by a given gro member was experimentally increased, his status as perceived by other grou members also increased.

Our investigation was also concerned with modification of duration of talking. Specifically, we were interested in determining the condition(s) under which the verbal interactions in a triad of *S*s could be manipulated so as to facilitate increases in the duration of talking by one member of the triad (critical subject or *CS*). The procedures employed in this investigation were very similar to those of Bavelas, *et al.* (1965) with one major exception. In the Bavelas, *et al.* study the group of *S*s sat around a table in full view of each other. It was quite possible that certain nonverbal behaviors (i.e., frowns, smiles, head-nods, etc.) were potential social reinforcing stimuli in addition to the mechanical reinforcing stimulus (light blink) programmed by *E*. In our investigation *S*s were placed in isolation booths and could not see each other. The results should therefore enable us to evaluate the extent to which verbal behavior in small groups can be manipulated when the social non-verbal cues have been minimized.

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METHOD

Reinforcement programs

On an *a priori* basis we chose to investigate five different programs of reinforcement. Each program was designed to answer some basic questions regarding group interaction. The programs and rationale are described below. In describing these programs that *S* in whom we wish to produce an increase in duration of talking will be referred to as the critical subject (*CS*). The other members of the triad will be referred to as noncritical subjects (*NCS*s). Interactions among the noncritical *S*s will be designated as *NCS-NCS* while interactions between a noncritical *S* and the critical *S* will be designated as *NCS-CS*. The reinforcement consisted of points which registered on a counter at the rate of one every 5 sec. of continuous speech. *S*s received money dependent upon the number of points they had received at the end of each experimental session.

Program I. In Program I only the *CS* was reinforced. The purpose of this program was to determine whether we could produce an increase in the amount of talking in the *CS* without direct experimental intervention of the *NCS*s.

Program II. This was a mutual reinforcement program in which the *CS* reinforced the *NCS*s when he talked to them and the *NCS*s reinforced the *CS* when they in turn talked to him. The rationale for this program is talking by the *CS* results in reinforcement for the *NCS*s and that this would increase the probability that they in turn would talk to the *CS*. Also extinction of the *NCS-NCS* interactions might increase the probability of the desired interactions.

Program III. In this program the *CS* could reinforce the *NCS*s by talking to them. However, the *CS* does not receive any reinforcement himself. Our intent with this program was to determine to what extent the *NCS*s' verbal behavior could produce and maintain increases in the verbal production of the *CS* independent of any point reinforcement for the *CS*.

Program IV. Program IV represents a combination of Programs I and III in that the *CS* dispensed points to whomever he was talking but in addition the *CS* himself obtained points while talking. Again extinction of the *NCS-NCS* interactions serves to increase the probability of the desired interactions.

Program V. This program is different from the other programs in that punishment was employed to suppress the interactions between the *NCS*s, that is, the *NCS*s lost points when talking to each other. In all other respects

Program V is identical to Program IV (i.e., the *CS* obtained points for talking no matter to whom he was talking and the *NCS* to whom he was talking obtained points).

Subjects

Ss were college sophomores drawn from introductory courses. A total of five triads participated; Nos. 1, 2, and 3 were from Florida State University and Nos. 4 and 5 from the University of Missouri at Kansas City. With the exception of one triad (No. 3), the members constituting each group were of the same sex.

Experimental design

Each triad of *Ss* participated in all reinforcement programs. In order to evaluate the stability of change produced by a given reinforcement program, there were three sessions of each program. Each daily session lasted 40 min. A one-day extinction period intervened between changes in reinforcement programs.

Since it is possible that reinforcement program sequence effects could be a limiting condition, a different order of reinforcement programs was administered to each triad of *Ss*. In three of the triads (Triads 1, 2, and 3) the *CS* was the same throughout all reinforcement programs. These triads will be referred to as constant critical-subject triads. The advantage of having the same *CS* participate in all reinforcement programs is that variability can be minimized and the relative effects of each program easily evaluated. On the other hand, a limitation of having the same *CS* throughout all programs is that there may be a built-in "transfer" effect so that the results of the program may be a function of the temporal sequence in which the program is introduced. Changing the *CS* as well as the program sequence could provide some additional information about the effectiveness of various programs. Therefore in two of the triads (Triads 4 and 5) the *CS* was not the same throughout the sequence of programs. These triads will be referred to as changing critical-subject triads.

The selection of the *CS* in the constant critical-subject triads was determined on the basis of a series of operant sessions. A minimum of three operant sessions were scheduled. At the end of these sessions the *CS* was selected. The criterion for selection of the *CS* was one of the two *Ss* in the triad who had the lowest duration of talking but who also had the most stable performance during the operant sessions. In instances where the variability was too large, there were additional operant sessions scheduled until at least one *S*'s performance stabilized. In each case, however, the operant data reported are on the basis of the last three operant days.

The selection of the *CS* for the first reinforcement program in the changing

critical-subject triads was on the same basis as the constant critical-subject triads. The selection of the *CS* in subsequent reinforcement programs was determined on the day-to-day performance of *S*s and our interest in determining the efficacy of a given reinforcement program or the manipulation of some facet of the group interaction.

Procedure

At the beginning of each session *S*s were led to their respective isolation booths and given a psychiatric case history to read. Each day they were given a different case history. During the operant sessions there was no reinforcement programmed as the purpose of these sessions was to establish a baseline upon which the effects of the reinforcement programs could be evaluated. During the conditioning sessions *S*s were told it was possible for them to gain or lose points during the course of their discussion. They were not informed of the basis on which points could be obtained and they were also cautioned not to discuss the point system with each other. At the end of each session the triad member who received the highest number of points received 75 cents, next highest 50 cents, and least 25 cents. In the event of a tie the money was split among the tied parties. The points were delivered according to the contingencies of the specific program under investigation. During the extinction sessions the point counters were simply inactivated and at the end of the session *S*s were informed that there was a three-way tie and the money was evenly divided.

RESULTS AND DISCUSSION

In Table 10-3 are presented the mean durations of talking of *CS*s during the operant and various reinforcement program sessions. The means are based on the three successive days of each program. In Triads 1, 2, and 3 the *CS* was

Table 10-3. Mean durations of talking (min.) of critical *S* during operant and reinforcement program sessions

Triad No.	Operant Session	Programs				
		I	II	III	IV	V
1	12.5	17.3 (38)*	13.8 (10)	12.6 (1)	15.2 (21)	19.3 (54)
2	6.3	9.0 (43)	13.0 (106)	15.2 (141)	12.7 (141)	16.5 (162)
3	11.5	11.7 (2)	15.7 (37)	12.0 (4)	11.5 (0)	14.3 (24)
4A	8.7		10.0 (15)	11.7 (34)	14.5 (67)	
4B	10.6	17.5 (65)				
4C	11.3					19.4 (72)
5A	5.4		7.9 (46)		14.0 (159)	14.2 (163)
5C	9.9	15.6 (58)		13.7 (38)		

*Numbers in parenthesis refer to percentage increase above operant level.

Table 10–4. Proportion of non-critical *Ss'* duration of talking to that of critical *S* during operant and reinforcement sessions

Triad No.	Operant Session	Program				
		I	II	III	IV	V
1	0.52	0.49	0.68	0.53	0.56	0.93
2	0.34	0.63	0.80	0.83	0.71	0.99
3	0.44	0.55	0.59	0.52	0.41	0.58
4A (BA+CA)	0.65		0.75	0.82	0.93	
4B (AB+CB)	0.35	0.62				
4C (AC+BC)	0.33					0.96
5A (BA+CA)	0.36		0.43		0.69	0.92
5C (AC+BC)	0.59	0.75		0.68		

the same throughout all programs. In Triads 4 and 5 individual members of the triad are listed since the *CS* varied from program to program. Subject B in Triad 5 never served as a *CS* because his duration of talking remained consistently high throughout most programs.

The results indicate considerable inter-triad variability in the effectiveness of each program. However, Program V clearly produced substantial increases in duration of talking above the operant baseline in all triads and compared to the other programs produced the largest magnitude of change in all but one triad.

Another procedure for evaluating the effectiveness of the various programs is to examine the changes in the *NCS-CS* interactions. Presumably increases in the duration of talking by the *CS* may be a function of the amount of talking the *NCS*s direct toward him. In Table 10–4 are presented the mean proportions of the *NCS*s' talking that was directed toward the *CS*. Again, as was the case in Table 10–3, the individual members of Triads 4 and 5 are listed. If Subject A were the *CS* for a given program, we would be interested in seeing the proportion of B's and of C's durations of talking which was directed toward A. Changes produced in the *NCS*s-*CS* interaction by the various programs can be compared with the respective operant session performance.

Again the results suggest that Program V was highly effective in producing an increase in the *NCS*s-*CS* interaction. Other programs produced varying amounts of change and Program I produced the least amount of change. The results of Program I might be anticipated since this was the only program in which there was no attempt to manipulate the *NCS*s. One inference that can be made from these results is that increasing the proportion of talking that the *NCS*s direct to the *CS* is not sufficient to produce increases in the *CS*'s duration of talking. An example may be found in Triad 1 where the *NCS*s-*CS* interaction in Program III is slightly higher than in Program I; yet as may be seen in Table 10–3, the *CS*'s duration of talking is substantially greater with Program I than with Program III.

Empirically, Program V is the most consistently effective program. This

is not too surprising inasmuch as this program incorporated the procedures used in all the other programs but in addition employed punishment to suppress the *NCS-NCS* interactions. However, despite its effectiveness in producing substantial changes in both the duration of *CS*'s talking and in the *NCS-CS* interactions, we found these effects to be only temporary. With the removal of the point contingencies during the extinction session following the program, we typically found a significant decline in the *CS*'s duration of talking and a decline in the *NCS-CS* interaction, with a concomitant increase in the *NCS-NCS* interaction.

It is interesting to note that results produced by Program V are similar to those obtained by Bavelas, *et al.* (1965). The results of their investigation disclosed that a conditioning procedure combining both positive reinforcement of the *CS* and punishment of the *NCS*s was more effective than procedures which involved only reinforcing the *CS* or only punishing the *NCS*s. Thus, despite the differences in the procedures between the Bavelas study and the present investigation, it appears that a program combining both reinforcement and punishment contingencies will produce changes in duration of talking. The results of our investigation extend the generality of the Bavelas findings in demonstrating that nonverbal behaviors, such as smiling and head-nods which may be potential social reinforcers, are not necessary to produce changes in duration of talking. However, it has not yet been demonstrated to what extent the experimentally produced changes in duration of talking are either maintained or generalized beyond the controlled environment of the laboratory. It seems that the changes we produced are only temporary. On the other hand, Bavelas, *et al.* demonstrated some maintenance effects and concomitant changes in sociometric rankings. It could be that social reinforcers which would include certain classes of verbal behavior as well as non-verbal behavior of the *NCS*s, while not necessary to produce initial changes in behavior when mechanical reinforcing stimuli are involved (i.e., points or lights), may be necessary to maintain these effects when the mechanical reinforcement is withdrawn. A systematic analysis of these variables might help to clarify these effects.

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11

DISORDERED SOCIAL BEHAVIOR

The factors that control social responses promote, in most instances, behavior which is considered "normal" or desirable. Occasionally, this control malfunctions or is improperly established and results in behavior aversive to the individual as well as to those around him; behavioral disorders have been mentioned under the various topics discussed in this book. For example, much human social behavior is competitive, and competitive behavior is viable only when occasional reinforcement occurs for all competitors. Similarly, relationships of mutual reinforcement can change to involve reinforcement for only one or some group members; again the relationship breaks down. Social reinforcement and imitation most often promote desirable social behavior. A failure to establish social reinforcers and imitative responses in individuals leads to severe behavioral deficits. Also, on some occasions, undesirable behavior may be socially reinforced or imitated. Among some of the phenomena classed as social facilitation, socially desirable behavior may be suppressed and socially undesirable behavior facilitated, as well as vice versa. Aggression, because it involves aversive stimuli, is almost always undesirable. An abundance of the stimuli and reinforcers which cause aggression leads to a destructively high rate of aggressive behavior. Affection and sexual behavior are desirable social behaviors, but their establishment depends on adequate early as well as current experience. Finally, deficits in verbal behavior are one of the most common behavioral deficits. Verbal deficits are caused by failures on the part of the social stimuli that are responsible for the acquisition and maintenance of verbal behavior.

A deficient or malfunctioning social environment is likely to produce numerous behavioral deficits and disorders in the individual it affects. When the behavioral disorders become general and extreme to the point where they are noticeable and interfere with the person's normal functioning, a person is said to be retarded, or psychotic, or criminal. This chapter presents studies that deal with these general behavioral disorders in terms of the social stimuli that cause them.

The approach of the papers presented here is typical of the behavioral approach to disordered behavior, which has proved successful in many clinical and nonclinical settings (Ayllon and Azrin, 1968; Ullman and Krasner, 1965; Ulrich, Stachnik and Mabry, 1966, 1970). The behavioral approach stands in opposition to the traditional method of treating behavior disorders, which characterizes the individual as "mentally ill." The disordered behaviors are traditionally regarded as symptoms of the underlying "illness." When a "medical model" such as this is accepted, little attempt is made to treat the symptoms directly since, supposedly, the illness will repeatedly manifest itself in new and different symptoms. Rather, an attempt is made to treat the internal psychological state of the person by urging him to express and examine his thoughts and feelings. In contrast, the behavioral approach begins with the very behavior neglected by traditional therapies. The disordered behavior, as is all behavior, is assumed to be the result of the individual's interaction with his environment; if the environment produces the behavior, the environment can also eliminate the behavior. Therapy is oriented toward behavior modification, i.e., elimination of the disordered behavior and establishment of the desired behavior. This is accomplished through the control of environmental stimuli and reinforcers. In the cases presented here, social stimuli are seen to be especially important in shaping and maintaining disordered behaviors.

The first paper examines the effect of social stimuli emitted by psychiatric nurses on the behavior of psychiatric patients. The paper is by T. Ayllon and J. Michael, and is entitled, "The psychiatric nurse as a behavioral engineer." Many of the "abnormal" or "psychotic" behaviors exhibited by the patients appeared to be maintained by social reinforcement from the nurses in the form of attention or approval. Therefore, Ayllon and Michael treated the behaviors by withholding reinforcement for undesired behaviors and sometimes by reinforcing incompatible behavior. Too frequent entering of the nurses' office by one patient and psychotic talk by another patient were decreased by withholding social reinforcement. In the latter case, the traditional treatment methods used by a social worker seemed to increase the incidence of psychotic talk. An attempt was made to control extreme aggressiveness in one patient by using social reinforcement to increase incompatible behavior. Self-feeding was increased, in part, by social reinforcement.

Social reinforcement will not be effective for all individuals with behavioral disorders; yet, social stimuli are apparently powerful controllers of behavior for many of these individuals. The explanation lies in the history of the individuals; in some cases social reinforcement has malfunctioned to shape and maintain undesirable behaviors. Ayllon and Michael simply reversed the procedure, and they obtained the desired results. This technique of environmental control is advantageous since social reinforcers are readily

available and inexpensive—they can be dispensed by a wide variety of treatment agents who require relatively little training. Most important, as the work of Ayllon and Michael shows, is the fact that social reinforcers are very often extremely effective in correcting behavior disorders.

The control the nurses acquired over the patients' behavior did not seem to suppress one "symptom" merely to increase another. Rather, the social stimuli dispensed by the nurses changed the patients' behavior and, hence, changed the responses which many other individuals made to the patients. As the patients' emission of behaviors aversive to other people diminished, aggression by others against the patients also diminished. Decreases in abnormal behavior allowed other individuals to interact more normally with the patients; therefore, the patients' behavior was more likely to come under the constructive control of normal social stimuli. A decrease in the abnormal behaviors of the patients made them more acceptable to individuals outside the institution and made their return to the community more likely (Ayllon, 1963).

The second paper presented in this chapter treats the behavior of autistic children in terms of social stimuli. The paper, by M. K. DeMeyer and C. B. Ferster, is entitled "Teaching New Social Behavior to Schizophrenic Children," and its approach to the treatment of autistic children is based on Ferster's analysis of autism.

Autistic children exhibit little social behavior of any kind. As Lovaas' work with autistic children showed, social reinforcers are frequently ineffective for these children (Lovaas, *et al.*, 1966). Ferster characterizes their social behavior as concerned primarily with using aversive stimuli to control the behavior of adults. Extreme verbal deficits and disorders are indicative also of the extent to which their social behavior is disordered. Ferster feels that one source of these social behavioral disorders lies in an abnormal relationship between social and nonsocial stimuli. Social stimuli usually become social reinforcers through association with nonsocial reinforcement; however, for many autistic children, social stimuli become associated with the *absence* of other reinforcement. This type of reinforcement history could explain the ineffectiveness of social reinforcers in some cases. For other autistic children, particularly those raised in punishing environments, social stimuli may come to be associated with aversive stimuli; the social stimuli then become conditioned aversive stimuli. This type of history could explain the emotional reaction that some autistic children show in response to social contact. In short, the children develop atypical responses to social stimuli.

Social stimuli are of great importance in the development and maintenance of human behavior; a child to whom social stimuli are ineffective or aversive

would be deprived of a powerful controller of his behavior and could easily develop the behavioral disorders known as autism. An additional problem is the fact that undesirable behaviors are frequently reinforced by adults. Many of the undesirable behaviors typical of autism appear to be maintained by the control they have over adult behavior. In behavioral terms, then, autism can be ascribed to an abnormal history of social conditioning and to reinforcement of the disordered behavior.

One treatment of autistic children recommended by Ferster involves using nonsocial stimuli such as food or a favorite toy to reinforce new behaviors. Also, by the association of social stimuli with nonsocial reinforcement, the social stimuli may become reinforcing. As seen in Chapter 3, Lovaas *et al.* (1966) did establish social reinforcers in autistic children by making social stimuli discriminative for reinforcement. A similar procedure is conducted more informally in Ferster and DeMyer's treatment programs. Indeed, the procedure known as "breaking the autistic barrier" seems to involve a change in the stimulus value of social stimuli. Exposure to the social stimuli presented by the therapist in the absence of aversive stimuli or in the presence of reinforcing stimuli seems to recondition the social stimuli, making them at least neutral, and preferably reinforcing, to the child.

DeMyer and Ferster, in outlining the behavioral changes produced by these methods, show that the treatment procedures are effective. The type of analysis made by DeMyer and Ferster is essential if abnormal behavior is to be approached on the behavioral level: the existing behavior of the person must be recorded and analyzed; treatment procedures must be specified and the resulting behavioral changes recorded. This methodology allows the design of an effective treatment program, helps the therapeutic personnel control their own behavior, and provides a check on the actual effectiveness of the program.

Disordered social behavior is not confined to institutional settings. Many of the everyday social relationships of "normal" people are made more difficult or aversive when malfunctions occur in social interactions. The third paper included in this chapter examines a malfunctioning social relationship between a husband and a wife. The paper is by G. R. Patterson and H. Hops and is entitled, "Coercion, a game for two: Intervention techniques for marital conflict." Much marital conflict appears to occur when couples rely primarily on aversive stimuli to control each other's behavior. Attempts to solve problems degenerate into an aggressive exchange, and the problem is often forgotten in the fray. Patterson and Hops attempt to teach a couple first to specify the behaviors they desire from each other. Then the couple is encouraged to arrive at agreements that reinforce desired behavior from one person with desired behavior from the other. When aversive control is used, it is in the form of "fines" agreed to by both parties.

G. R. Patterson has been particularly active in designing strategies for changing social relationships in the natural environment. In the paper included here, the clients are encouraged to record their own behavior at home. In other work with married couples (Patterson and Rosenberry, 1969) and with disturbed children (Patterson, McNeal, Hawkins, and Phelps, 1967), an observer enters the home and records social interactions by speaking into a face mask. Since the object even of treatment in an institution is to remove the person from the institution, ultimately the therapist must learn to deal with the home environment. As objective methods are developed to "track" social interchange outside the laboratory, intervention in informal settings should become more and more successful (see also Bernal, 1970; Stuart, 1970).

The papers presented in this chapter deal with disordered relationships usually regarded as "mental illness" or "adjustment" problems. Criminal behavior is another disordered social behavior. The distinction between criminal behavior and "mental illness" is primarily legal (Morris and Hawkins, 1969). From a behavioral point of view, both the criminal and the psychotic are exhibiting undesired behaviors produced and maintained by malfunctioning relations between the individual and his environment. A behavioral treatment program that views criminal behavior as a special social problem would have a great potential for success because of the obvious reinforcers involved in criminal activities. To the editors' knowledge, no behavioral program designed to modify criminal behavior has been attempted.

Criminal behavior has been analyzed on a theoretical level within a behavioral framework (e.g., Jeffery, unpublished manuscript). Crimes are often reinforced. Theft may be reinforced by obtaining a car, a color TV set, or money. Crimes against persons may sometimes be reinforced by removal of the person as an aversive stimulus (Jeffery, unpublished manuscript). Crimes may be socially reinforced by members of the peer group, as perhaps occurs in some "gangs." Crimes, especially crimes against persons, may be an aggressive response to aversive stimuli; murder and assault appear to occur regardless of any material reinforcement.

Crimes committed for material reinforcers could be reduced by reducing the motivational factors that make the reinforcers reinforcing. A person with a high income will not steal a color TV set unless reinforcers other than material ones are involved. Teenagers from affluent social backgrounds commit crimes apparently for social reinforcement. Social reinforcement for crime is difficult to eliminate. Currently, some efforts are being made to change the reinforcement structure of "gangs" by reinforcing acceptable behavior. An example would be a legitimate business venture administered by a "gang," which could replace more undesirable methods of obtaining economic as well as social reinforcers.

Today punishment is the method most often used to suppress criminal behavior; if it is sufficiently aversive and reliably delivered immediately following a response, it will suppress such behavior. Imprisonment is extremely aversive, but it seldom follows criminal behavior very closely. Even arrest, which sometimes immediately follows a criminal response, is very aversive. Punishment probably does suppress criminal behavior in many individuals. However, society's present system of punishment is obviously an inadequate suppressor of criminal behavior. Crimes are often unpunished, while non-criminal behavior sometimes is. Punishment often has very little temporal relation to crime. In addition, punishment of one undesirable behavior may increase the incidence of another undesirable behavior less likely to be punished. Finally, the aversive stimuli used in punishment are very likely to cause aggression.

The reinforcement system in which the police operate may defeat its own purpose by actually increasing the incidence of crimes against persons. Police are reinforced for making arrests; on the other hand, the threat of punishment lurks for the policeman in the form of aggression from the criminal. In so-called "victimless" crimes, such as those involving drug use or sexual behavior, arrest can be made with little fear of punishment from the arrestee. Arrest for crimes involving violence is obviously more difficult and dangerous. The police officer operating in a certain area is, therefore, more likely to spend his time arresting derelicts or homosexuals than in patrolling dark alleys. If society desires to control violent crime by punishment, the reinforcement conditions operating on the punishing agents should be designed to maximize their behavior.

Reduction of the aversive stimuli present in the environment would probably do much to reduce crime. Crime is most prevalent in environments where aversive stimuli are also most prevalent. Racial discrimination involves countless aversive stimuli; so does poverty. The fact that crime rates are high among low-income minority groups could be predicted from these two facts alone. The situation is often exacerbated by the punishment of desirable behavior, such as the seeking of employment.

Widespread reform of our society will be necessary to change the motivational conditions and reduce the aversive stimuli responsible for much crime. Machinery that could be used to change the criminal behavior of individuals already exists in the form of the penal system. People are being placed in prison and on parole; in both of these situations, strong control over the individual's behavior is exercised. At present, however, the control is squandered. The current penal system appears to create criminal behavior as much as eliminate it. Sachar (1963) has summarized the situation as follows:

> Crime statistics suggest that the penalty system works well as a technique of deterrence and correction in certain areas, such as the enforcement of traffic laws and in certain types of 'white collar' crimes. For certain other serious criminal problems, however, such as crimes of violence and drug addiction, the technique seems to have relatively little effectiveness. No one knows with certainty, of course, how many people are deterred from crime by fear of punishment, but the high rate of recidivism indicates that such fear does not work in the case of those who seem to need deterrence most. In a study to be published next year, Daniel Glasser of the University of Illinois estimates that 50 percent of all felons discharged from prison have later trouble with the law and that 35 percent are back in prison within three years. Among youthful offenders, who represent the major crime problem, the rate of recidivism is considerably higher . . ." (p. 43).

The failure of the penal system appears to be related to the punitive attitude that society promotes in regard to crime (Sachar, 1963). If the desire for rehabilitation were sincere, society would supply the resources to make modification of criminal behavior possible. Time spent in prison or on parole could be used to create new, noncriminal behavior in response to the old familiar stimulus conditions that led to the development of the criminal behavior. These new responses hopefully would make return to criminal behavior less likely. Unfortunately, at present most programs designed to make life more pleasant for criminals are met by the public with little enthusiasm. It is fashionable to attribute criminal behavior to factors such as hypnosis, chromosomes, and drugs, while more than ample cause for criminal behavior lies in the everyday environment of many human beings. A more realistic approach to the nature and causes of criminal behavior could bring, for the first time in most memories, a reduction in criminal behavior.

Whether disordered behavior is psychotic or criminal, it is often created and maintained by the social environmental stimulus and reinforcement conditions. Changes in the social environment can, therefore, modify the behavior. Advances in understanding of social behavior will further enhance our ability to prevent and to modify disordered behavior. The present understanding of behavior is sufficient to make significant improvements in disordered behavior; the understanding remains to be applied on a large scale.

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The psychiatric nurse as a behavioral engineer

Teodoro Ayllon
and
Jack Michael

The behavior which leads to a person's admission to a mental hospital often involves danger to himself or others, withdrawal from normal social functions, or a dramatic change from his usual mode of behaving. The professional staff of the psychiatric hospital directs its major efforts toward the discovery of the flaw in the patient's mental apparatus which presumably underlies his disturbing and dangerous behavior. Following the medical paradigm, it is presumed that once the basic disfunction has been properly identified the appropriate treatment will be undertaken and the various manifestations of the disfunction will disappear.

While diagnosis is being made and during subsequent treatment, the patient is under the daily care of the psychiatric nurses in the ward.[1] There, he often exhibits annoying and disrupting behavior which is usually regarded as a further manifestation of his basic difficulty. This behavior is sometimes identical with that which led to his admission; but at other times it seems to originate and develop within the hospital setting. Although it is still regarded as a reflection of his basic problem, this disruptive behavior may become so

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Additional information and related research are found in T. Ayllon and N. Azrin, *The Token Economy: A Motivational System for Therapy and Rehabilitation.* New York: Appleton-Century-Crofts, 1968.

[1] As used in this paper, "psychiatric nurse" is a generic term including all those who actually work on the ward (aides, psychiatric nurses, and registered nurses).

persistent that it engages the full energies of the nurses, and postpones, sometimes permanently, any effort on their part to deal with the so-called basic problem.

Disrupting behaviors usually consist in the patient's failure to engage in activities which are considered normal and necessary; or his persistent engagement in activities that are harmful to himself or other patients, or disrupting in other ways. For example, failures to eat, dress, bathe, interact socially with other patients, and walk without being led are invariably disruptive. Hoarding various objects, hitting, pinching, spitting on other patients, constant attention-seeking actions with respect to the nurses, upsetting chairs in the dayroom, scraping paint from the walls, breaking windows, stuffing paper in the mouth and ears, walking on haunches or while in a squatting position are disruptive when they occur frequently and persistently.

At present, no systematic approach to such problems is available to the nurses. A psychodynamic interpretation is often given by psychiatrists and psychologists; and, for that matter, the nurses sometimes construct "depth" interpretations themselves. These interpretations seldom suggest any specific remedial actions to the nurses, who then have no other recourse than to act on the basis of common sense, or to take advantage of the physical therapy in vogue. From the point of view of modern behavior theory, such strong behaviors, or behavioral deficits, may be considered the result of events occurring in the patient's immediate or historical environment rather than the manifestations of his mental disorder. The present research represents an attempt to discover and manipulate some of these environmental variables for the purpose of modifying the problem behavior.

RESEARCH SETTING

The research was carried out at the Saskatchewan Hospital, Weyburn, Saskatchewan, Canada. It is a psychiatric hospital with approximately 1500 patients. Its most relevant features in terms of the present experiment are:

1. The nurses are trained as psychiatric nurses in a 3-year program.

2. They are responsible for the patients in their wards and enjoy a high degree of autonomy with respect to the treatment of a patient. The psychiatrists in the hospital function as advisers to the nursing staff. This means that psychiatrists do not give orders, but simply offer advice upon request from the psychiatric nurses.

3. The nurses administer incoming and outgoing mail for the patients, visitor traffic, ground passes, paroles, and even discharge, although the last is often carried out after consultation with a psychiatrist. The nurses also conduct group therapy under the supervision of the psychiatric staff.

The official position of the senior author, hereafter referred to as *E*, was

that of a clinical psychologist, who designed and supervised operant-conditioning "therapy" as applied by the nurses. Once his advice had been accepted, the nurses were responsible for carrying out the procedures specified by *E*. It was the privilage of the nurses to discontinue any treatment when they believed it was no longer necessary, when they were unable to implement it because of lack of staff, or when other ward difficulties made the treatment impossible. Whenever termination became necessary, *E* was given appropriate notice.

SUBJECTS

The subjects used in this investigation were all patients in the hospital. Of the total 19 patients, 14 had been classified as schizophrenic and 5 as mentally defective. Except for one female patient who was resident for only 7 months, all patients had been hospitalized for several years. Each subject presented a persistent behavior problem for which he had been referred to *E* by the nursing staff. None of the *S*s was presently receiving psychotherapy, electroconvulsive therapy, or any kind of individual treatment.

The behaviors which were studied do not represent the most serious problems encountered in a typical psychiatric hospital. They were selected mainly because their persistence allowed them to survive several attempts at altering them.

PROCEDURE

Prior to a systematic observational study of the patient's behavior the nurses were asked about the kind and frequency of naturally occurring reinforcement obtained by the patient, the duration and frequency of the problem behavior, and the possibility of controlling the reinforcement. Next, a period of systematic observation of each patient was undertaken prior to treatment. This was done to obtain objective information on the frequency of the behavior that was a problem to the nurses, and to determine what other behaviors were emitted by the patient.

Depending on the type of behavior, two methods were used for recording it. If the behavior involved interaction with a nurse, it was recorded every time it occurred. Entering the nurses' office, and eating regular meals are examples of such behavior.

Behavior which did not naturally involve contact with the nurse was recorded by a time-sampling technique. The nurse who was in charge of the program was supplied with a mimeographed record form. She sought out the patient at regular intervals; and without interaction with him, she recorded the behavior taking place at that time. She did not actually describe

the behavior occurring, but rather classified it in terms of a pre-established trichotomy: (a) the undesirable behavior; (b) incompatible behavior which could ultimately displace the undesirable behavior; and (c) incompatible behavior which was not considered shapeable, such as sleeping, eating, and dressing. (Although these latter acts are certainly susceptible to the influence of reinforcement, they were regarded as neutral behaviors in the present research.) The period of observation varied from 1 to 3 minutes. After making an observation, the nurse resumed her regular ward activities until the next interval was reached, whereupon she again sought out the patient. Except for one patient, who was observed every 15 minutes, such observations were made every 30 minutes.

The relevant aspect of the data obtained by the time-check recording is the proportion of the total number of observations (excluding observations of neutral behavior) during which the patient was engaging in the behavior being altered. This will be called the relative frequency of the behavior. As an example, on the first day of the program of extinction for psychotic talk in the case of Helen (see below), 17 nonneutral behaviors were recorded. Of these, nine were classed as psychotic talk and eight as sensible talk; the relative frequency of psychotic talk was 0·53.

Although it would have been desirable, a long pretreatment period of observation was precluded by the newness of this approach and the necessity of obtaining the voluntary cooperation of the nurses.

After the pretreatment study had been completed, *E* instructed the ward nurses in the specific program that was to be carried out. In all cases the instruction was given at ward meetings and usually involved the cooperation of only two shifts, the 7 a.m. to 3 p.m., and 3 p.m. to 11 p.m., since the patients were usually asleep during the 11 p.m. to 7 a.m. shift.

The pretreatment studies indicated that what maintained undesirable behavior in most of the patients was the attention or social approval of the nurses toward that behavior. Therefore, the emphasis in instructing the nursing staff was on the operation of giving or withholding social reinforcement contingent upon a desired class of behavior. What follows illustrates the tenor of *E*'s somewhat informal instructions to the nurses. "Reinforcement is something you do for or with a patient, for example, offering candy or a cigarette. Any way you convey attention to the patient is reinforcing. Patients may be reinforced if you answer their questions, talk to them, or let them know by your reaction that you are aware of their presence. The common-sense expression 'pay no attention' is perhaps closest to what must be done to discourage the patient's behavior. When we say 'do not reinforce a behavior,' we are actually saying 'ignore the behavior and act deaf and blind whenever it occurs.' "

When reinforcement was given on a fixed-interval basis, the nurse was instructed to observe the patient for about 1 to 3 minutes at regular intervals, just as in the pretreatment observation period. If desirable behavior was

occurring at the time of observation, she would reinforce it; if not, she would go on about her duties and check again after the next interval had passed. Strictly speaking, this is fixed interval with a limited-hold contingency (Ferster & Skinner, 1957). During a program of extinction the nurse checked as above; however, instead of reinforcing the patient when he exhibited the behavior being altered, she simply recorded it and continued her other work. Except for specific directions for two patients, the nurses were not given instructions on the operation of aversive control.

The programs requiring time-sample observations started after breakfast (around 9 a.m.) and ended at bedtime (around 9 p.m.), and were usually carried out by only one of the 6 to 12 nurses on each shift. Because of the daily shift changes, the monthly ward rotations, and a systematic effort to give everyone experience at this new duty, no patient's program was followed by any one nurse for any considerable length of time. Nineteen, as a minimum, different nurses were involved in carrying out each patient's program. Over 100 different nurses participated in the entire research project.

Most social ward activities took place in the dayroom, which was a large living room containing a television set, card tables, magazines, and games. It was here that reinforcement was given for social behaviors toward patients, and for nonsocial behaviors which were strengthened to compete with undesirable behaviors. The fact that the research was carried out in five wards distributed far from each other in a four-floor building made it impossible for *E* to observe all the nurses involved in the research at any one time. Because of the constant change in nursing personnel, most of *E*'s time was spent in instructing new people in the routines of the programs. In addition, since *E* did not train the nurses extensively, he observed them, often without their knowledge, and supervised them in record keeping, administering reinforcement, extinction, etc. That the nurses performed effectively when *E* was absent can be at least partially determined by the ultimate results.

RESULTS

The results will be summarized in terms of the type of behavior problem and the operations used in altering the behavior. In general, the time required to change a specific behavior ranged from 6 to 11 weeks. The operations were in force for 24 hours a day, 7 days a week.

Strong behavior treated by extinction, or extinction combined with reinforcement for incompatible behavior

In the five cases treated with this program, the reinforcer was the attention of the nurses; and the withholding of this reinforcer resulted in the expected decline in frequency. The changes occurring in three of the behavior problems,

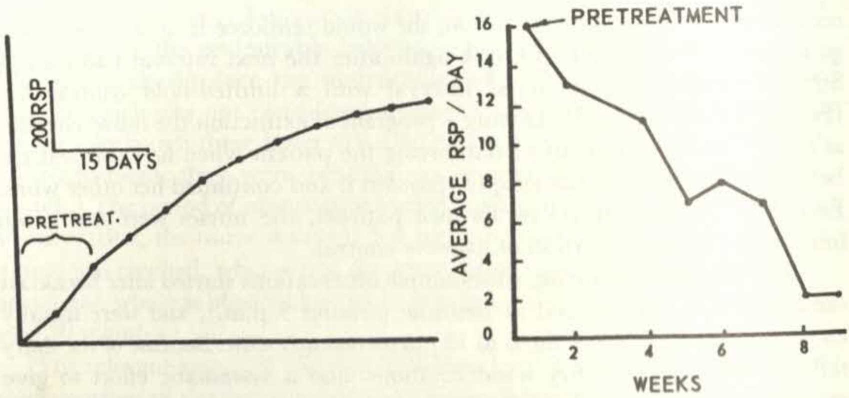

Figure 11–1. Extinction of the response "entering the nurses' office;" a. cumulative record, b. conventional record.

scrubbing the floor, spending too much time in the bathroom, and one of the two cases of entering the nurses' offices, were not complicated by uncontrollable variables. Lucille's case is presented in detail as representative of these three. The interpretation of the changes occurring in the other two behavior problems, entering the nurses' offices, and psychotic verbal behavior, is not so clear-cut. Helen's case illustrates this point. For details concerning the cases not discussed in this paper, see Ayllon (1959).

Lucille. Lucille's frequent visits to the nurses' office interrupted and interfered with their work. She had been doing this for 2 years. During this time, she had been told that she was not expected to spend her time in the nurses' office. Frequently, she was taken by the hand or pushed back bodily into the ward. Because the patient was classified as mentally defective, the nurses had resigned themselves to tolerating her behavior. As one of the nurses put it, "It's difficult to tell her anything because she can't understand—she's too dumb."

The following instructions were given to the nurses: "During this program the patient must not be given reinforcement (attention) for entering the nurses' office. Tally every time she enters the office."

The pretreatment study indicated that she entered the office on an average of 16 times a day. As Figure 11–1b shows, the average frequency was down to two entries per day by the seventh week of extinction, and the program was terminated. Figure 11–1a shows the same data plotted cumulatively.

Helen. This patient's psychotic talk had persisted for at least 3 years. It had become so annoying during the last 4 months prior to treatment that other patients had on several occasions beaten her in an effort to keep her quiet.

She was described by one of the psychiatrists as a "delusional" patient who "feels she must push her troubles onto somebody else, and by doing this she feels she is free." Her conversation centered around her illegitimate child and the men she claimed were constantly pursuing her. It was the nurses' impression that the patient had "nothing else to talk about."

A 5-day pretreatment observation of the patient was made at 30-minute intervals to compare the relative frequencies of psychotic and sensible content in her talk. Some of the nurses reported that, previously, when the patient started her psychotic talk, they listened to her in an effort to get at the "roots of her problem." A few nurses stated that they did not listen to what she was saying but simply nodded and remarked, "Yes, I understand," or some such comment, the purpose of which was to steer the patient's conversation onto some other topic. These reports suggested that the psychotic talk was being maintained by the nurses' reaction to it. While it is recognized that a distinction between psychotic and normal talk is somewhat arbitrary, this case was included in the research because of its value as a problem involving primarily verbal behavior.

The following instructions were given to the nurses: "During this program the patient must not be given reinforcement (attention) for her psychotic talk (about her illegitimate child and the men chasing her). Check the patient every 30 minutes, and (a) tally for psychotic talk; and (b) reinforce (and tally) sensible talk. If another patient fights with her, avoid making an issue of it. Simply stop the other patient from hurting her, but do so with a matter-of-fact attitude."

The 5-day observation period resulted in a relative frequency of psychotic talk of 0.91. During treatment (Figure 11-2), the relative frequency dropped to less than 0.25; but, later on, it rose to a value exceeded only by the pretreatment level. The sudden increase in the patient's psychotic talk in the ninth week probably occurred because the patient had been talking to a social

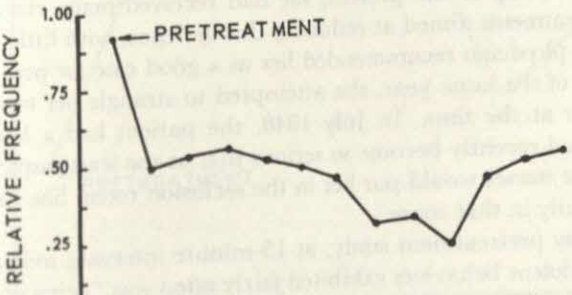

Figure 11-2 Extinction of psychotic talk.

worker, who, unknown to the nurses, had been reinforcing her psychotic talk. The reinforcement obtained from the social worker appeared to generalize to her interaction with other patients and nurses. The patient herself told one of the nurses, "Well, you're not listening to me. I'll have to go and see Miss ________ (the social worker) again, 'cause she told me that if she would listen to my past she could help me."

In addition to the reinforcement attributable to the social worker, two other instances of bootleg reinforcement came to light. One instance occurred when a hospital employee came to visit the ward, and, another, when volunteer ladies came to entertain the patients. These occasions were impossible to control, and indicate some of the difficulties of long-term control over verbal behavior.

It is of interest to note that since the reinforcement program began, the patient has not been attacked by the other patients and is only rarely abused verbally. These improvements were commented upon by the nurses, who were nevertheless somewhat disappointed. On the basis of the improvement shown in verbal behavior, the nurses had expected a dramatic overall change which did not occur.

Strong behavior treated by strengthening incompatible behavior

This case represented an attempt to control violent behavior by strengthening an incompatible class of responses, and to recondition normal social approaches while the violence was under control. The first phase was quite successful; but errors in strategy plagued the last half of the program, and it was terminated by the nurses because the patient became more violent.

The immediate reason for referral was that the patient, Dotty, had become increasingly violent over the last 5 years, and recently attacked several patients and hospital personnel without any apparent reason. Since admission and up to the present, she had received many electroconvulsive-therapy treatments aimed at reducing this violence, with little or no success. In 1947, a physician recommended her as a good case for psychosurgery. In December of the same year, she attempted to strangle her mother who was visiting her at the time. In July 1948, the patient had a leucotomy. The situation had recently become so serious that at the least suspicious move on her part the nurses would put her in the seclusion room. She spent from 3 to 12 hours daily in that room.

A 5-day pretreatment study, at 15-minute intervals, indicated that one of the nonviolent behaviors exhibited fairly often was "being on the floor" in the dayroom. The response included lying, squatting, kneeling, and sitting on the floor. Strengthening this class of responses would control the violence and, at the same time, permit the emotional behavior of other patients and nurses toward her to extinguish. To strengthen the patient's own social

behavior, her approaches to the nurses were to be reinforced. The response "approach to nurse" was defined as spontaneous requests, questions or comments made by the patient to the nurse. Ultimately, the plan was to discontinue reinforcing being on the floor once the patient-nurse social interaction appeared somewhat normal. Presumably, this would have further increased the probability of approach to the nurses.

For the duration of the program, continuous social reinforcement was to be available for her approach to the nurses. Social reinforcement was to be available for the first 4 weeks only, on a fixed interval of 15 minutes, contingent on the response being on the floor. For the last 4 weeks, social reinforcement was to be withheld for being on the floor.

The following instructions were given to the nurses for the first 4 weeks of the program: "Reinforce (and tally) her approaches to you every time they occur. Check the patient every 15 minutes, and reinforce (and tally) the behavior being on the floor."

From the fifth week on the instructions were modified as follows: "Continue reinforcing (and tallying) her approaches to you every time they occur. Check the patient every 15 minutes, and tally but do not reinforce the behavior being on the floor."

During the period of reinforcement, as shown in Figure 11-3, the relative frequency of the response being on the floor increased from the pretreatment level of less than 0.10 to a value of 0.21. During the succeeding 4 weeks of extinction, the frequency of being on the floor returned to the pretreatment level.

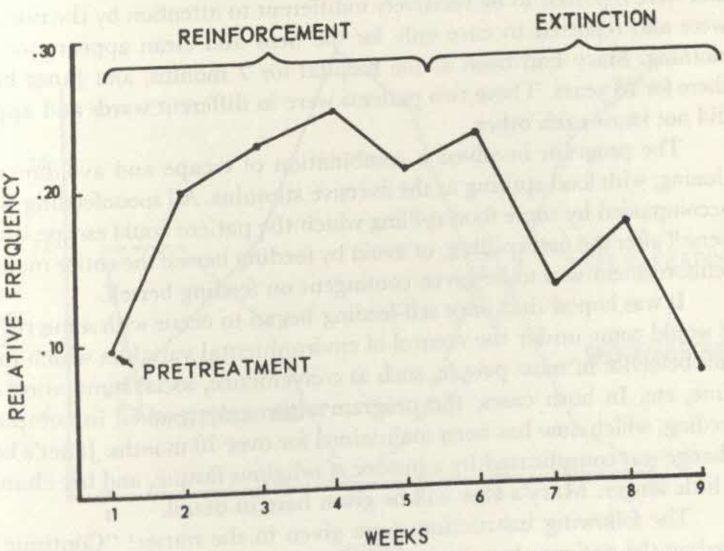

Figure 11-3. Reinforcement and subsequent extinction of the response "being on the floor."

It was clear that being on the floor was incompatible with the fighting behavior and that the latter could be controlled by reinforcing the former. During the period of reinforcement for being on the floor, she attacked a patient once; but during the period of extinction, she made eight attacks on others. Her approaches to nurses increased overall during the 4 weeks of reinforcement, but they decreased during the last 4 weeks, even though they were still being reinforced. This decrease paralleled the decrease in being on the floor. While being on the floor was undergoing extinction, attacks on the patients and nurses increased in frequency, and the nurses decided to return to the practice of restraining the patient. The program was terminated at this point.

The patient's failure to make the transition from being on the floor to approaching the nurses suggests that the latter response was poorly chosen. It was relatively incompatible with being on the floor. This meant that a previously reinforced response would have to be extinguished before the transition was possible, and this, too, was poor strategy with a violent patient.

Weak behavior strengthened by escape and avoidance conditioning

Two female patients generally refused to eat unless aided by the nurses. One, Janet, had to be forcefully taken to the dining room, where she would permit the nurses to spoonfeed her. The other patient, Mary, was spoonfed in a room adjacent to the dining room. Both patients had little social contact with others and were reported to be relatively indifferent to attention by the nurses. Both were also reported to care only for the neat and clean appearance of their clothing. Mary had been at the hospital for 7 months, and Janet had been there for 28 years. These two patients were in different wards and apparently did not know each other.

The program involved a combination of escape and avoidance conditioning, with food spilling as the aversive stimulus. All spoonfeeding was to be accompanied by some food spilling which the patient could escape by feeding herself after the first spilling, or avoid by feeding herself the entire meal. Social reinforcement was to be given contingent on feeding herself.

It was hoped that once self-feeding began to occur with some regularity, it would come under the control of environmental variables which maintain this behavior in most people, such as convenience, social stimulation at meal time, etc. In both cases, the program ultimately resulted in complete self-feeding, which now has been maintained for over 10 months. Janet's behavior change was complicated by a history of religious fasting, and her change took a little longer. Mary's case will be given here in detail.

The following instructions were given to the nurses: "Continue spoon-feeding the patient; but from now on, do it in such a careless way that the patient will have a few drops of food fall on her dress. Be sure not to overdo

the food dropping, since what we want to convey to the patient is that it is difficult to spoonfeed a grown-up person, and not that we are mean to her. What we expect is that the patient will find it difficult to depend on your skill to feed her. You will still be feeding her, but you will simply be less efficient in doing a good job of it. As the patient likes having her clothes clean, she will have to choose between feeding herself and keeping her clothes clean, or being fed by others and risking getting her clothes soiled. Whenever she eats on her own, be sure to stay with her for a while (3 minutes is enough), talking to her, or simply being seated with her. We do this to reinforce her eating on her own. In the experience of the patient, people become nicer when she eats on her own."

During the 8-day pretreatment study, the patient ate 5 meals on her own, was spoonfed 12, and refused to eat 7. Her weight at this time was 99 pounds. Her typical reaction to the schedule was as follows: the nurse would start spoonfeeding her; but after one or two "good" spoonfuls, the nurse would carelessly drop some food on her dress. This was continued until either the patient requested the spoon, or the nurse continued spoonfeeding her the entire meal. The behaviors the patient adopted included (a) reaching for the spoon after a few drops had fallen on her dress; (b) eating completely on her own; (c) closing her mouth so that spoonfeeding was terminated; or (d) being spoonfed the entire meal. Upon starting the schedule, the most frequent of all these alternatives was the first; but after a while, the patient ate on her own immediately. The relevant data are shown in Figure 11-4. On the 12th day, the patient ate all three meals on her own for the first time. Four meals were

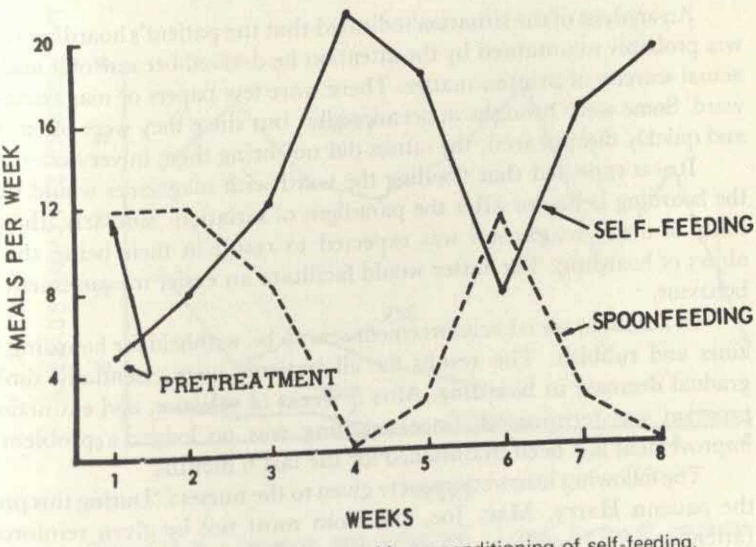

Figure 11-4. Escape and avoidance conditioning of self-feeding.

refused out of the last 24: one meal was missed because she stated she didn't like "liver" and the other three because she said she was not hungry. Her weight when she left the hospital was 120 pounds, a gain of 21 pounds over her pretreatment weight.

Mary's relapse in the fifth week, after she had been eating well for 2 weeks, was quite unexpected. No reasonable explanation is suggested by a study of her daily records; but, after she had been spoonfed several meals in a row, the rumor developed that someone had informed the patient that the food spilling was not accidental. In any event, the failure to feed herself lasted only about 5 days.

Since the patient's hospital admission had been based on her refusal to eat, accompanied by statements that the food was poisoned, the success of the program led to her discharge. It is to be noted that although nothing was done to deal directly with her claims that the food was poisoned, these statements dropped out of her repertoire as she began to eat on her own.

Strong behavior weakened through a combination of extinction for social attention and stimulus satiation

For 5 years, several mentally defective patients in the same ward, Harry, Joe, Tom, and Mac, had collected papers, rubbish, and magazines and carried these around with them inside their clothing next to their body. The most serious offender was Harry, whose hoarding resulted in skin rashes. He carried so much trash and so persistently that for the last 5 years the nurses routinely "dejunked" him several times during the day and before he went to bed.

An analysis of the situation indicated that the patient's hoarding behavior was probably maintained by the attention he derived because of it and by the actual scarcity of printed matter. There were few papers or magazines in the ward. Some were brought in occasionally; but since they were often torn up and quickly disappeared, the nurses did not bring them in very often.

It was expected that flooding the ward with magazines would decrease the hoarding behavior after the paradigm of satiation. Similarly, the availability of many magazines was expected to result in their being the major object of hoarding. The latter would facilitate an easier measurement of this behavior.

In addition, social reinforcement was to be withheld for hoarding magazines and rubbish. The results for all patients were essentially similar: a gradual decrease in hoarding. After 9 weeks of satiation and extinction, the program was terminated, since hoarding was no longer a problem. This improvement has been maintained for the last 6 months.

The following instructions were given to the nurses: "During this program the patients Harry, Mac, Joe, and Tom must not be given reinforcement (attention) for hoarding. There will be a full supply of magazines in the

dayroom. Every night, after all patients have gone to bed, replenish the magazine supply in the dayroom. Every night while the patients are in bed, check their clothes to record the amount of hoarding. Do not, however, take their hoarding from them."

The original plan was to count the number of magazines in the patients' clothing after they had gone to bed. This is, in fact, the dependent variable shown in Figure 11-5 for Joe, Tom, and Mac. The recording for Harry had to be changed, however; after 4 days of the program, he no longer carried the rubbish or magazines in his clothing. Instead, he kept a stack of magazines on his lap while he was sitting in the dayroom. The number of magazines in his stack was counted when he left the dayroom for supper, and this is the dependent variable shown for Harry in Figure 11-5. (Mac was out of the ward for 3 weeks because of illness.)

Prior to the program, one of the nurses questioned the possibility and even advisability of changing Harry's behavior. Her argument was that "behavior has its roots in the personality of the individual. The fact that he hoards so much indicates that Harry has a strong need for security. I don't see how we are going to change this need, and I also wonder if it is a good thing to do that." This was a point of view commonly encountered, especially regarding relatively nonverbal patients.

It would seem in this case that Harry transferred his security needs from hoarding rubbish and magazines to sitting in the dayroom and looking at magazines, especially during T.V. commercials. The transfer occurred with no apparent signs of discomfort on his part.

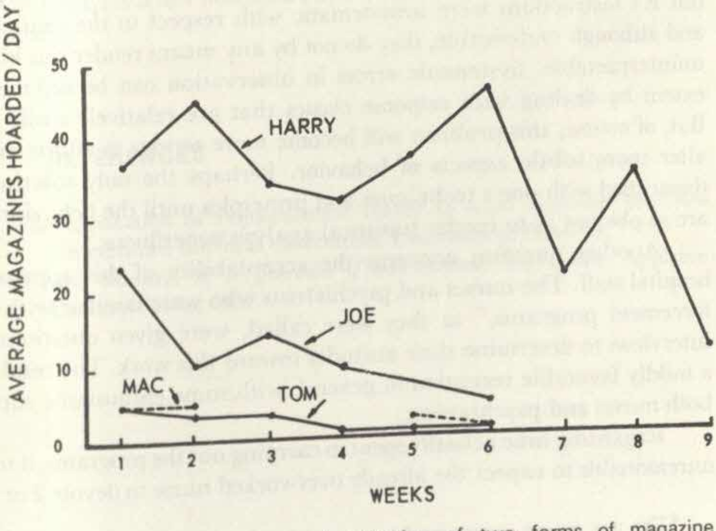

Figure 11-5. Satiation and extinction of two forms of magazine hoarding.

Other cases

Combinations of extinction, reinforcement, and avoidance programs were set up for three patients; in two of these the problem behavior was eliminated in only a few weeks. The program of the third patient was followed for 20 days and then terminated since he had shown no changes by that time. An interpretation of the outcome of each of these programs is rendered questionable by the number of controlling variables involved and the nature of the changes.

The pretreatment study of four additional patients showed that the problem behavior of three of them did not occur often enough to justify carrying through a program; and in the fourth case, no easily controllable variables were available and, again, no program was undertaken.

DISCUSSION

On the basis of this work, further research along the same lines is now under way.[2] The present results are presented in this preliminary form in the hopes that they will provide encouragement to those who are in a position to conduct similar research. Therefore, it will be useful to mention a few other aspects of this work.

A major problem concerns the use of nurses as experimental assistants as well as substitutes for the recording and programming apparatus of the laboratory. There is no question as to the greater reliability of the ordinary laboratory component. In large part, however, the nurses' failures in carrying out *E*'s instructions were unsystematic with respect to the results obtained, and although undesirable, they do not by any means render this kind of work uninterpretable. Systematic errors in observation can be reduced to some extent by dealing with response classes that are relatively easily identified. But, of course, this problem will become more serious as efforts are made to alter more subtle aspects of behavior. Perhaps the only solution is to be dissatisfied with one's techniques and principles until the behavioral changes are so obvious as to render statistical analysis superfluous.

Another question concerns the acceptability of this approach to the hospital staff. The nurses and psychiatrists who were familiar with the "reinforcement programs," as they were called, were given questionnaires and interviews to determine their attitudes toward this work. The results indicate a mildly favorable reception in general, with some enthusiastic support from both nurses and psychiatrists.

Regarding time actually spent in carrying out the programs, it might seem unreasonable to expect the already overworked nurse to devote 2 or 3 minutes

[2] This new project is supported by a grant from the Commonwealth Fund, and is being conducted under the auspices of the Saskatchewan Hospital, Weyburn, Saskatchewan, Canada.

every half-hour to observation and recording. However, this is only about 40 minutes of an 8-hour shift; and, besides, much of her work stems from patients' behavior problems, the elimination of which would make the 40 minutes an excellent investment of time.

Two sources of possible misunderstanding between *E* and nurses should be pointed out. First, when nurses were asked about the sort of problems they had in the ward, if no dramatic behaviors, such as attempts at suicide, or violent acts, had been recently reported, they often denied having any problems. Problems also went unrecognized because they were considered unsolvable. For example, since most nurses attributed the behavior of a patient to his diagnosis or age, little or no effort was made to discover and manipulate possibly relevant environmental variables.

Second, even after a behavior had been modified, it was not uncommon to hear nurses remark, "We've changed her behavior. So what? She's still psychotic." It seemed that once a persistent problem behavior was eliminated, its previous importance was forgotten and other undesirable aspects of the patient's repertoire were assumed to be the most important ones. In general, their specific expectations were unclear or unverbalized, and they tended to be somewhat dissatisfied with any change less than total "cure."

Finally, an objection often raised against this approach is that the behavior changes may be only temporary. However, permanent elimination of ward behavior problems requires a permanent elimination of the environmental variables that shape them up and maintain them. The clinical belief that a favorable change, if properly accomplished, will be permanent probably rests on a faulty evaluation of the role of environmental variables in controlling behavior. Certainly, it is not based on any actual accomplishments in the field of mental health.

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Teaching new social behavior to schizophrenic children

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and
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Since Kanner described the syndrome of early infantile autism in 1944 and Margaret Mahler differentiated the symbolic child in 1952, continuous efforts to treat these types of children have met with only sporadic successes (Eisenberg, 1957). Much of the literature dealing with treatment of these severely ill children discusses types of approaches used in the one-to-one therapy situation by professionally trained therapists (Ekstein, 1954; Waal, 1955). This paper tells of a study in a residential treatment setting using untrained psychotherapists, consisting of child-care workers, nurses, and teachers, as the principal therapists of a group of autistic and symbiotic children. The treatment is a combined individual-milieu process directed by a psychiatrist.

DESCRIPTION OF STUDY

Children studied

The patients studied consisted of eight children, sexes equally divided, ranging in age from two to ten years when the project began November, 1959. The diagnosis in three probably conforms to Kanner's description of early infantile autism, and in two to Mahler's symbiotic child. The remaining three children have features characteristic of both descriptions. At the start of the study each of the children showed the common characteristics of an extremely narrow range of behavioral repertoires, disorders in speech ranging from muteness to atypical speech with reversal of pronouns and echolalia, lack of or capricious control over affectual expression, rage reactions with certain changes in

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routine, serious problems in self-identification (Rabinovitch, 1954) and interpersonal relationships.

Background of study

Previous therapy with severely schizophrenic children on the Carter Hospital Children's Service had been done mainly by psychologists and psychiatrists, with the child-care workers participating on a marginal basis. Several factors played a role in the minimal success of the program, one being that professionally trained therapists spent at best only three or four hours per week with the child; most of the time the child was with untrained workers. These workers could not take up where the therapist left off because it was often impossible for them to comprehend the complex, dynamically oriented framework of the therapy. Since all psychotherapy is essentially a learning experience, with the therapist becoming for the child one of the chief reinforcers and punishers of behavior, the question was raised as to whether a less complex theory of learning might be used by child-care workers in a treatment situation to modify the behavior of the child and to convert human beings into acceptable objects for the autistic child.

On the basis of its simplicity and thus its potential workability by the untrained therapists, the theory of operant conditioning with the concept of reinforcement (Skinner, 1953; Ferster, 1958) was chosen as a therapeutic tool. Reinforcement refers to a technique for increasing the frequency of an activity by following the act with specific consequences in the environment. Previous work with the same type of children in an automatically controlled experiment by Ferster and DeMyer (1962) has shown the feasibility of using these concepts. In this study social methods have been the reinforcers, a form of free operant conditioning (Skinner, 1953).

Method of study

The first step in the program was to observe carefully each child's pattern of behavior. Behavior was then categorized as follows:

(1) response of child to approach of adult (affective response, eye-to-eye contact, receptivity-avoidance behavior)
(2) response to approach of other children
(3) use of toys and inanimate objects
(4) use of own body
(5) verbal behavior
(6) changes in environment disturbing to child
(7) responses to daily routine
 (a) sleeping, eating, elimination
 (b) scheduled activities.

On the basis of the detailed observations a second step was taken. Tentative social overtures were made carefully by the child-care workers so that the behavioral pattern of the child would not be interrupted. The pattern of behavior of most young schizophrenic children is the manipulation of a few objects in an endless, repetitive fashion, the exploitation of their own bodies or body products for immediate pleasure, and rage reactions or anxiety attacks when another individual upsets this routine, either by forcing him to do something else or by failing to set the stage so that the routine may be completed as usual. The first step in our process was designed to help the adult insinuate himself into the behavior pattern of the child without upsetting him. The technique is a familiar one used by many therapists with autistic children; it has been termed "resolving the autistic barrier" (Betz, 1947). As soon as the child was accepting these social overtures, then the adult who was generally most successful was selected to do individual work with the child. Three children had more than one therapist. The individual worker and the project director decided together which aspects of the child's behavior would be selected for shaping. For one half hour, three or four times a week the children were seen individually by a child-care worker, a nurse, or a teacher. During these half hours the adult used as reinforcers the social contacts found pleasurable to the child in the initial phase of the study. These reinforcers varied with each child, but in general consisted of verbal praise and reassurance, the type of physical contact acceptable to the child, and reading, singing, playing music, and dancing. The type of activity selected for reinforcement in the beginning was generally something that would have the most likelihood of success in that the new activity would be a broadening of some activity already in the child's repertoire. As the child acquired a new activity, the worker would also learn new reinforcers so that the interaction between the two of them took on more depth and variety.

Because describing the process with each child is too complex for a short paper, the methods and results for the eight children are listed in outline form; the work with one four-year-old child, Pete, is described in detail to exemplify the process. In most ways it is typical of that used with all eight children.

Behavioral observations on Pete

1. *Response to adults*: If adults interrupted a routine or failed to give Pete something he wanted, he would butt them with his head and often bite them. Sometimes he would pucker up his lips as if he were going to kiss an adult, only to bite him instead. He did not respond to his name being called. He paid no attention to emotional reactions of adults. He showed no eye-to-eye contact. He used adults to make possible the continuation of narrow behavioral patterns.

2. *Response to children*: This was essentially the same as his response to adults.

3. *Use of toys and inanimate objects*: There was a heavy concentration on inanimate objects and toys in his total day's activity. However, he never used them appropriately; he played with toys by flipping, sucking, or spinning them. He spent much time moving doors, turning the knobs, or sucking them.

4. *Use of own body:* He looked at his hands and feet. Sometimes he sat on his knees with feet tucked under his buttocks, then he would slowly scoot one foot out, and as it came into view he would laugh uproariously. He examined his fingers while he put them in queer postures. He was vigorous in activity of running up and down the hall.

5. *Verbal behavior*: He cried, screamed, and yelled at changes in routine or when wishes were denied. When playing by himself he frequently let out a high-pitched "ah-ah-ah-ee-ee-ee" sound. He had been known in his home to sing snatches of songs with his mother.

6. *Changes in environment disturbing to the child*: Rage reactions resulted from changes in position of doors and attempts to make him give up his characteristic use of objects.

7. *Response to daily routines* (a) Sleeping, eating, elimination: He was a poor sleeper, would not go to sleep until late at night, and took no naps during the day. He ate nothing by himself. His diet consisted of milk, and strained baby food. He was not toilet trained. (b) Scheduled activities: He did not participate in music or art. Outdoor activities were turned into a repetition of his usual behavioral pattern. He did not play in dirt or finger paints.

In the first stage of the experiment when workers were trying to find if they could insinuate themselves into his behavior pattern, the first contact he allowed with equanimity was that of the adult standing close to him and talking to him when he was playing with doors, and of holding his hand when he was seemingly fearful. Gradually he allowed brief moments of eye-to-eye contact and finally went to personnel when they called his name. He then also allowed people to pick him up and, for the first time, he raised his arms to be picked up. At this stage of Pete's response to adults, the second part of the study, the teaching of new social behavior could begin. The counselor selected for individual work had noted that Pete looked at him closely when the counselor rode a large tricycle. For several days the counselor smiled and talked to Pete as the counselor rode the tricycle. Then for several days he placed the boy briefly on the seat. Each time Pete sat there the counselor rewarded him by carrying him on his shoulders, telling him he was a fine boy. After two weeks Pete was riding the tricycle. It was his first appropriate use of a toy. Shortly after he learned to use the tricycle he had several vacation days, spending his time at home. He lost the appropriate use of the tricycle, a facility he regained in two weeks.

Also participating in Pete's program were a man teacher, a woman teacher, and an occupational therapist. While the counselor concentrated on teaching him to play appropriately with toys, the teachers and occupational

therapist developed his vocalization, speech, listening to music, and working with simple art media. In these special times again the reinforcements used were such things as verbal encouragement, carrying him, the woman teacher's kissing him and holding him. These social reinforcers at first would be delivered as soon as Pete would perform a part of the activity the therapist was trying to develop; finally only the exact performance was rewarded.

RESULT OF STUDY

The results of the study are difficult to ascertain because other approaches were used with the children, and much attention was directed toward planning a program for each child's day. Most of the time and effort was made to use the principle of operant reinforcement in activities such as art and music, but often this goal was not attained. However, changes in the behavior of the individual children can be categorized roughly in two ways: those results directly attributable to the social shaping program, and general behavior changes not so attributable. All the cases have been studied within these categories and tabulated.

Results with Pete

In the case of Pete, the results which were considered attributable to the effect of the social shaping program were:

1. *Response to adults*: He responded to the approach of adults in most situations by kissing them, looking at them, and wanted to be picked up; there was great increase in response to verbal directions.

2. *Response to children*: There was no effort to change his behavior in regard to other children in the shaping program.

3 & 4. *Use of toys and inanimate objects; use of own body*: He could ride a tricycle, a rocking horse, push a train on a track, and play a record player. There was a general decrease in flipping of objects, amount of time spent with doors, and mouthing of objects. However, without a good deal of specific stimulation, he reverted to his former patterns of behavior with objects and his body.

5. *Verbal behavior*: There was an increase in vocal sounds, he said a few words, and hummed tunes learned in music.

6. *Changes in environment disturbing to the child*: The child allowed many more changes in his environment without anxiety reactions.

7. *Response to daily routines*: There was no specific effort to use a shaping program in sleeping, eating, and elimination. As far as scheduled activities were concerned, he showed a great deal of interest in music and some interest in drawing.

General behavioral changes not specifically attributed to the shaping

program that Pete manifested were a willingness to approach other children, staying in a room with his family, and a desire for his mother and father to hold him a great deal. He began to play appropriately with his sister, responding to her directions in play activities. There was appropriate response to the emotional state of his mother and that of other children. For example, during a period when his mother was under much pressure and cried in front of him several times, he would go over to her, pull her hand away from her eyes and look with a sad expression into her face, then respond with a smile when she would cease crying. On one occasion when the counselor had the children in a group and most of them were saying "Hello," Pete did not respond. The counselor said to him, "Pete, aren't you ashamed of yourself? All the other children can say 'Hello,' and here you are not saying it." In a few seconds Pete said "Hello." In his response to daily routines he began to sleep the night through, going to bed at an early hour and not waking up. He now feeds himself a variety of solid foods and is practically toilet trained. Outdoors he plays appropriately with outside toys and plays in the dirt, an activity he never before engaged in.

Results with other children

The results of this study of eight children are described in the following outline below. We could not include more than the general response of the children to the reinforcements, nor could we include all of the reinforcements tried. The children's responses to the social reinforcements were highly variable from day to day. Those listed in the outline are the most consistently successful. We learned from this study that some of the children's devotion to their rituals on many occasions was not so strong as their motivation to thwart the adults. For example, one child (K.S.) played for weeks with cardboard boxes, tearing to shreds any box she could get hold of and crying whenever she saw a box. This kind of behavior during a certain period far eclipsed any other. We purposely did not reinforce her playing with boxes since it was obviously used to withdraw from people and other environmental stimuli. We then decided to use cardboard boxes as a reinforcer because all other reinforcers were failing. On the first occasion that we presented the box as a reinforcer, the child refused it and thereafter showed no interest in boxes.

DATA ON OTHER CHILDREN

K.P., $2\frac{3}{4}$ yrs., autistic[1]

BEHAVIOR AT START OF STUDY

1. No eye-to-eye contact. Inspected pocketbooks of women and pockets of men. Otherwise ignored adults.

[1] All children, with one exception, were in the program for ten months. The exception was H. C., who was in the program for only five months.

2. Ignored other children.

3. Toys: played with sand and water pouring it over herself for hours at a time. Little interest in playing with toys, but much mouthing of objects.

4. Stood in one spot rocking sidewise from one foot to another for long periods. Much masturbation. Moaned and twitched on the floor if wants were not met. She did like to rock and sit near adults. Ate paper. Had a frown on her face most of the time.

5. No words. No babbling. Screaming and moaning if thwarted.

6. Upset in any change of her behavioral pattern.

7. Slept late in the morning. Eating fairly good, except that she would not sit at the table but ran around the tables snatching food from other people's plates. Not toilet trained. No interest in scheduled activities.

METHOD OF ATTAINING PLEASURE-PRODUCING ADULT CONTACT WITH CHILD

1. Holding, rocking, patting.

2. Singing, talking to her, smiling, looking at her directly.

BEHAVIOR SELECTED FOR SHAPING

1. Develop eye-to-eye contact.

2. Playing with toys.

3. Toilet training.

REINFORCEMENTS—SOCIAL

1. Half an hour four times every week with O.T.

2. Half an hour three times every week with teacher.

3. Counselor assigned to take care of most physical needs and toilet training.

4. All three people held her, praised her, kissed her when she played with toys, looked at picture books, urinated in toilet, looked at or interacted with other children.

RESULTS ATTRIBUTABLE DIRECTLY TO SOCIAL SHAPING PROGRAM

1. Played with several toys appropriately.

2. Toilet training nearly accomplished.

3. Looked at books.

4. Patting, looking at, chasing other children; resentful if another child took away possessions or attention of favorite adults.

GENERAL BEHAVIORAL CHANGES[2]

1. More friendly, more outgoing.

2. Smiles often at appropriate times.

[2] All "General Behavior Changes" in all children listed here refer to the period covered by this study, i.e., November 21, 1959 to August 1, 1960.

3. Jabbers, says a few words.

4. Directly conveys her wishes by friendly appropriate actions rather than by screaming and yelling.

T. B., 10 yrs., symbiotic-autistic

BEHAVIOR AT START OF STUDY

1. Allowed no physical contact. Eye-to-eye contact. Screaming, hitting self and adults if thwarted. Often had this sort of reaction without known provocation. Principal response to adults was avoidance.

2. Urinated in other children's beds. Pulled their toys away from them, destroying them.

3. Toys, inanimate objects: smashed anything he could with his hands or under a table leg. Played with clay, using his urine to soften it. No appropriate use of toys.

4. Use of body: played often in own urine. Some masturbation. Grim, dour facial expression.

5. Verbal behavior: some grunting, screaming. In three years he said three separate phrases. Made no pleasurable sounds.

6. Any change in his behavioral pattern was upsetting to him.

7. Slept, ate well. Took no responsibility for toileting, except to urinate any place that struck fancy. No interest in adult-sponsored activities.

METHOD OF ATTAINING PLEASURE-PRODUCING ADULT CONTACT WITH CHILD

1. Going swimming.
2. Going for walks outside hospital.
3. Holding him when he was hitting himself or banging his head.

BEHAVIOR SELECTED FOR SHAPING

1. Develop interest in music activity.
2. Color with crayons instead of smashing them.
3. Develop more varied vocalizations.

REINFORCEMENTS—SOCIAL

1. During music period counselor rode child on shoulders in circle when child looked at or came close to children involved in music games.

2. During art period counselor played tumble games after T.B. marked on paper instead of smashing crayon.

3. Verbal praise, imitating T.'s sounds when he made pleasurable ones.

RESULTS ATTRIBUTABLE DIRECTLY TO SOCIAL SHAPING PROGRAM

1. Marching in music circles with smile on face.
2. Coloring with crayons consistently.
3. Humming tunes sung during music period throughout day.

GENERAL BEHAVIORAL CHANGES

1. Generally appears smiling and relaxed.
2. Seeks both adults and children more often for affection, kisses them, dances around room with them.
3. Fewer tantrums and self-destructive acts.

B. S., 8 yrs., symbiotic-autistic

BEHAVIOR AT START OF STUDY

1. Grabbed adults' glasses, dug fingernails into their ears, gritted her teeth and smiled when an adult displeased her, smelled adults' hair, pinched adults. Sought out men more than women. Most of her response to adults was aggressively tinged. She had eye-to-eye contact.
2. Ran from older boys crying. Pushed and pulled hair of other children. Grabbed toys. Knocked children. Knocked children off riding toys.
3. Put clothes in toilet. Drank from toilet. Clutched toys to her; did not play with them, but tore them up.
4. When thwarted she would roll, hit her head on the floor, hit and scratch self, and pull out her hair.
5. No speech, just grunting and grimacing.
6. Any forced change in behavioral pattern was upsetting.
7. Sleeping, eating good. Some smearing of feces. Not consistently responsible for toilet. No interest in scheduled activities.

METHOD OF ATTAINING PLEASURE-PRODUCING ADULT CONTACT WITH CHILD

1. Giving physical and verbal attention before she could pinch or dig in adults' ears or hurt herself.
2. Hold her hands and smile and talk with her.

BEHAVIOR SELECTED FOR SHAPING

1. Develop interest in rock-a-boat.
2. Play face-and-hand games.
3. Develop new methods for expressing her anger other than self-mutiliation, gritting teeth, and smiling.

REINFORCEMENTS—SOCIAL

1. One hour each day with nurse who took her to snack bar; after one half hour of playing face-hand games, encouraging her to frown when angry.
2. Ball-and-paper throwing on ward with adult.

RESULTS ATTRIBUTABLE DIRECTLY TO SOCIAL SHAPING PROGRAM

1. Self-destructive activity ceased.
2. For a while great interest in face-hand games and said few words. This activity ceased when Mrs. M— absent for long period; it was never regained.

3. No longer smiles when other actions show she is angry.

GENERAL BEHAVIORAL CHANGES

1. Little general change in behavior except improved physical status and disappearance of self-destructive behavior.

2. Few adults could work comfortably with her.

R. M., 8 yrs., symbiotic

BEHAVIOR AT START OF STUDY

1. Never wanted to be left alone. Pinched arms, twisted fingers of adults.

2. Pushed peers down, twisted their fingers, pinched them. When with bigger boys trembles and puts hands over ears.

3. Small toys, sticks, pencils, he knocked together furiously, mumbling to himself. This was a favorite activity with little acceptable social interaction with peers. Could color well, but difficult to get him interested in any activity but the hitting of small toys and objects together.

4. Often stamped feet, trembled, put his hands over ears when upset. Overly neat and clean. Not much large-muscle activity.

5. He has a large vocabulary. Speaks in sentences, but with most people he speaks so rapidly in a high breathless way that they cannot understand him.

6. Is particularly upset if he has to take responsibility for a large-muscle activity on his own or with a change in any scheduled routine.

7. Often sleeps poorly. Eats poorly. Urinates in pants with responsibility for fecal elimination. Goes along with all scheduled activities.

METHOD OF ATTAINING PLEASURE-PRODUCING ADULT CONTACT WITH CHILD

1. Verbal reassurance when trembling or running to adult for protection.

2. Coloring or pasting with him.

3. Close attention during music period.

BEHAVIOR SELECTED FOR SHAPING

1. Interest in rough-and-tumble games.

2. Converting pinching to throwing, boxing, running.

3. Decrease neatness and cleanliness.

REINFORCEMENTS—SOCIAL

1. One half hour each day with recreation person who praised him for each effort to play a jumping or roughhouse game and verbally discouraged pinching.

2. Praise, attention by adult whenever he gets in sandbox or becomes dirty; was dressed in old clothes.

RESULTS ATTRIBUTABLE DIRECTLY TO SOCIAL SHAPING PROGRAM

1. Pinching, pushing nearly replaced by acceptable roughhouse games.
2. Decrease in neatness, greater comfort when dirty.

GENERAL BEHAVIORAL CHANGES

1. Began to relive, with mother, days before and after "break" (period of great anxiety and hallucinations at age of five), going over things said and done then, getting reassurance from her that he is not a bad boy, getting her permission to be dirty.
2. Taking dancing lessons with his sister.
3. Roughhousing often with his father.
4. Much conversation at home.

K. K., 7 yrs., symbiotic

BEHAVIOR AT START OF STUDY

1. Fearful of physical closeness, demanding of adults. Refused to accept any set limits. Often ignored adults by engaging in repetitive, purposeless, stereotyped play. Laughing and crying inappropriately. Misidentification of people, particularly men.
2. Did not play with other children. Fearful of the children. Aggressive toward smaller children. Misidentification of children.
3. Played constantly with shoes. Wandered from one toy to another, playing with none.
4. Ritualistic finger flipping. Constantly washing her hands, masturbating, self-destructive (butts head, hits chin with fists).
5. Usually spoke in sentences with a reversal of pronouns or using third person.

6 & 7. Eating: large appetite. Sleeping: demanded lights be on until she went to sleep. Elimination: went after activities. No response over changes.

METHOD OF ATTAINING PLEASURE-PRODUCING ADULT CONTACT WITH CHILD

1. Allowing K.K. to be a little baby with her own bottle.
2. Joining in her play with inanimate objects (shoes, purse).

BEHAVIOR SELECTED FOR SHAPING

1. Encouraging doll-house play, painting, water play.
2. Encourage her in doing things for others, such as getting cigarettes and matches out of purse, running small errands.
3. Developing proper use of pronouns.

REINFORCEMENTS—SOCIAL

1. Praising child for appropriate response, such as playing with doll

house, referring to self as "I." (She was particularly responsive to praise from one teacher.)

2. Reassurance and encouragement.

RESULTS ATTRIBUTABLE DIRECTLY TO SOCIAL SHAPING PROGRAM

1. K.K. plays with doll house for fifteen-minute periods. Paints.

2. She is able to carry on a conversation using "I" and without reversing pronouns.

GENERAL BEHAVIORAL CHANGES

1. No longer needs light on until asleep.

2. Talks about going to activities, able to discuss a change in schedule, plays with shoes and body less, plays occasionally with other children, not aggressive to little children.

3. Differentiates people properly.

4. Eats less.

5. Compulsive hand washing ceased.

H. C., 6 yrs., autistic

BEHAVIOR AT START OF STUDY

1. He believed each new woman coming on the ward was his mother. He believed this for a period of about two weeks, then believed some other new person was his mother. He constantly felt the elbows of women; called them breasts. Often hit out at women when upset.

2. Some appropriate interaction with peers. However, he often pretended he was Superman and that he was flying.

3. Used large-muscle toys appropriately.

4. Constantly in motion, screaming, yelling, hitting head when displeased.

5. Some speech for expressing immediate needs and some of his thoughts, often quite bizarre.

6. Any change in routine upset him, particularly if he was playing alone that he was Superman.

7. Some sleep disturbances. Ate fairly well. Responsible for own elimination. Music period especially upsetting to him. Cried, hit, screamed; hit his head during this period. He would respond by drawing to art activities. Played outdoors.

METHOD OF ATTAINING PLEASURE-PRODUCING ADULT CONTACT WITH CHILD

1. Holding him.

2. Reading simple stories to him.

BEHAVIOR SELECTED FOR SHAPING

1. To help him attain pleasure in an adult woman even after he had decided she was not his mother.

2. Focus on drawing activities.

REINFORCEMENTS—SOCIAL

1. Reading to him, sitting beside him in his quiet moments.

2. One half hour four times a week with nurse to draw with him and try to observe other reinforcing social stimuli.

RESULTS ATTRIBUTABLE DIRECTLY TO SOCIAL SHAPING PROGRAM

1. Less hyperactivity.

GENERAL BEHAVIORAL CHANGES

1. During the period his father brought him irregularly to the day-care program he changed little. Just as he was beginning to be less hyperactive, he contracted measles, developed measles encephalitis and died.

C. S., 5 yrs., autistic

BEHAVIOR AT START OF STUDY

1. Played with adults' hair, face, and elbows. Avoided adults, walking away when they approached her. Shunned adults' affection.

2. Avoided all peers. Showed no interest in their activities and never looked at them.

3. Looked at TV frequently and at self in the mirror. Looked often at magazines. Play with other toys extremely limited.

4. Hit herself. Slapped arms and hands on wall and her legs on the floor. Kicked and scratched her face. Often put hands behind ears. Lies on the floor often.

5. Jabbered TV commercials at a rapid rate so that words nearly unintelligible. Whined and fretted often. No language for communication.

6. Upset with any change of her routine.

7. Poor sleeper. Finicky eater. Responsible for own elimination. No interest in adult-sponsored activities.

METHOD OF ATTAINING PLEASURE-PRODUCING ADULT CONTACT WITH CHILD

1. Sitting beside child, pointing out objects in magazines, reading slogans and pointing to words (she would take adult's hand and indicate she wanted this).

2. Repeating understandable words, an action which brought a smile to her face.

BEHAVIOR SELECTED FOR SHAPING

1. Using her speech and interest in magazines to develop closer physical contacts and more verbalization with adults.

REINFORCEMENTS—SOCIAL

1. Half an hour, four times every week with counselor in room. Counselor praised her for playing appropriately with doll house, read to her when child allowed counselor to sit beside her or pick her up.

RESULTS ATTRIBUTABLE DIRECTLY TO SOCIAL SHAPING PROGRAM

1. Child learned to recognize words, in a sense to "read."
2. Allowed adults to pick her up, approached them for affection.

GENERAL BEHAVIORAL CHANGES

1. Sleeps better.
2. Approaching neighborhood children and talking to them; e.g. child offered her a rose and C.S. said, "My, that's pretty." Noticing her peers on dorm.
3. Fewer tantrums, less destructive to self and to others.
4. Joins music and art activities on ward.

P. K., 4 yrs., autistic[3]

BEHAVIOR AT START OF STUDY

1. If adult failed to set stage for his routine behavior, he butted or bit the adult. Wide ambivalence. No response to name or emotional reaction of others. No eye-to-eye contact.
2. Behavior with children essentially same as with adults.
3. Spent most of day flipping, sucking, or spinning toys, positioning doors, turning and sucking door knobs.
4. Looked often at hands and feet while putting them in strange postures.
5. Cried, screamed, yelled with changes in routine or denial of wishes. Frequently emitted high-pitched sounds. No words, except at home occasionally sang snatches of songs with mother.
6. Poor sleeper, would not feed self; diet consisted of milk and strained baby food; not toilet trained. No interest in scheduled activities. Refused to play in dirt and finger paints.

METHOD OF ATTAINING PLEASURE-PRODUCING ADULT CONTACT WITH CHILD

1. Adult stood close and talked to him while playing with doors.
2. Later holding him and riding him on shoulders.

[3] P. K. is Pete, more extensively described above.

BEHAVIOR SELECTED FOR SHAPING

1. Appropriate use of toys.
2. Listening to music.
3. Play with art media and dirt.
4. Developing words.

REINFORCEMENTS—SOCIAL

1. Verbal encouragements, carrying him, kissing.

RESULTS ATTRIBUTABLE DIRECTLY TO SOCIAL SHAPING PROGRAM

1. Responded to adults' approach by kissing them, looking at them, holding out arms to be picked up; appropriate response to verbal directions.

2. Used several toys appropriately and decreased amount of ritualistic use of body, toys, and doors.

3. Babbling, saying a few words, humming tunes.

4. Allowed several environmental changes without anxiety reactions.

5. Interested in music.

GENERAL BEHAVIORAL CHANGES

1. Approaches other children and staying in a room with family. Sometimes plays with sister. Responds to other's emotional expression.

2. Sleeps night through, feeding self a variety of foods, nearly toilet trained, plays in dirt.

DISCUSSION OF RESULTS

The evaluation of the effectiveness of any psychotherapeutic intervention is a difficult problem (Eisenberg, 1957). These troubles are compounded in a residential treatment unit because so many things are done with the child and so many people come in contact with him. Thus the study in no sense could be rigidly controlled. Because the group of children was small and because there were no attempts at quantification of data, only general impressions can be given. With all of the children, it was possible to change their behavior by the use of social reinforcements in a predicted direction.

There appear to be two important elements in limiting the range and variety of behavior that can emerge from this technique as it was utilized in this study. The older children were more difficult to deal with in all steps of the process. We relied heavily in the first stages on physical contact, such as kissing and picking up the children, playing rough-and-tumble games, and cuddling them. In the case of the older children, it was more difficult for the workers to use such methods, partly because of size considerations, and partly because this activity was not so rewarding to the adults as it was with the younger children; thus they did not put as much energy into this process. In

the cases of the two younger children, ages two and four, the results seemed to be most far-reaching. Perhaps the changes in the oldest boy, a ten-year-old who before this program was introduced had responded little, were the most amazing to the staff. The boy changed from a child who always appeared dour and angry to a smiling one, often humming a tune, and seeking both adults and children for affection. In terms of age appropriateness, however, his activities are still at a much younger level, whereas with the three younger children, the changes have resulted in the total pattern of behavior reaching a more nearly age-appropriate level. This result is to be expected, of course. Another observation in two of the children (B. S. and H. C.) with whom the program had little success was that there were many interruptions during the procedures.

It is not possible to evaluate whether the technique used by an individual can be transferred successfully to another person without the child losing the new behavior he has gained, because in general there has been excellent daily attendance of the workers, and there have been no resignations among the people working on the project.

From this initial study it is possible to say that the technique of social reinforcements to teach new social behavior to autistic and symbiotic children is one that can be learned successfully by professionally untrained psychotherapists, that some changes in behavior directly attributable to the reinforcement program can be predicted, and that changes are more likely to be closer to age appropriateness in the very young children than in those older than six.

We cannot state that these results are more likely to be permanently successful than approaches based on other theories. Nor can we state that all improvement in this group of children resulted from this teaching process since other techniques, such as interpretation based on other theories, were used, and most of the children had many contacts with changing parents in treatment.

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Coercion, a game for two:

Intervention techniques for marital conflict

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Coercion is a special form of dyad interchange in which both persons provide aversive stimuli which control the behavior of the other (Patterson and Cobb, 1971). The negative reinforcement resulting from the termination of the aversive stimuli serves to strengthen the behavior of both parties. Following such an interchange there is an increase in the probability that a comparable form of interaction will continue in the future. For example, the following may occur:

> Wife: "You still haven't fixed that screen door."
>
> Husband: (Makes no observable response, but sits surrounded by his newspaper.)

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Wife: (There is a decided rise in the decibel level of her voice.) "A lot of thanks I get for all I do. You said three weeks ago—"

Husband: "Damn it, stop nagging at me. As soon as I walk in here and try to read the paper I get yelling and bitching."

Wife (shouting now): "You're so damn lazy that's all I can do to get things done!"

Husband: "All right, damn it, I'll fix it later! Now leave me alone!"

In this situation, the husband has trained his wife to increase the "volume" in order to get him to comply. She is more likely to resort to shouting next time she needs some change in his behavior. He, on the other hand, has learned that a vague promise will "turn off the pain."

The coercion paradigm is defined by the well-understood mechanism of negative reinforcement. Over a series of interchanges, the two persons train each other to become increasingly destructive. The present report relates the paradigm to marital conflicts and describes the intervention program used for a couple in serious conflict. Observation data and other criterion measures were developed to evaluate the outcome of applying the procedures.

In each coercive interchange, the aversive behavior of one member is strengthened. Over a series of trials several outcomes may occur. One person may learn to avoid these confrontations altogether by submitting early in each interaction sequence. His behavior is reinforced by avoiding the more intense aversive behaviors which occur if he persists in noncomplying. However, it is likely that as one member uses aversive stimuli to control behavior, that the other member of the dyad will also introduce it. According to the coercion hypothesis outlined by Patterson and Reid (1970), there is generally an equity in the exchange of (observable) aversive stimuli. Their analysis, based upon observed family interactions, showed a median correlation of 0.65 between the proportion of aversive interaction "given" and "received." This suggests that as one member initiates the coercive process, another is likely to also use it and thus increase the rate of aversive interchanges among all members. Thus it becomes more likely that marriage "partners," for example, may escalate the amplitude of pain required to terminate aversive behavior. The victim may train her husband such that *only* a severe physical attack will stop her nagging tongue. Occasionally, such escalation may go too far and result in the death of one of the members, as reflected in the homicide statistics showing that, in a substantial number of cases, the victims and murderers were members of the same families (Wolfgang and Ferracuti, 1967). Most coercive interactions among marriage partners do not, of course, reach this stage of training, because long before it is reached, one partner submits to the coercion of the other or leaves the marriage.

It is assumed that most marriages, by necessity, are characterized by the coercive process, and that this necessity arises in extended interactions

found in any closed system. If two people live together, they quickly reach the point where it is necessary to alter some behavior of the other person. Usually the behaviors are relatively trivial things such as "leaving his clothes laying about," or "she doesn't have dinner on time." While the changes could be produced by the systematic application of positive social reinforcement for the desired response, few persons have been trained to do this. The first alternative employed by most couples is to "talk about the problem." While these discussions may lead to permanent changes in behavior, it is our assumption that they do not. One, or more, members "forget" to follow through on the agreements; at this point, the victim "demands" that the other person change his behavior. If the other person does not comply, the victim is likely to use aversive stimuli to attempt behavior changes in the offending party.

As used here, the term conflict refers to the interchange where one party does not comply with implicit or explicit demands for *immediate* changes in behavior made by the other. The process continues and may escalate with commensurate increases in the bitterness of the attacks unless one person gives in or leaves the situation.

An important by-product of this increase in the exchange of aversive stimuli lies in the concommitant reduction in the ability of either member to change the behavior of the other. It is hypothesized that demands for behavior change accompanied by aversive stimuli will produce an immediate counter-attack rather than any alteration of the existing problem. The counter-attack in turn produces a further attack and the couple is effectively "side-tracked" from any possible solution of the problem. The fact that the problem still exists suggests that the interchange will occur again, with monotonous regularity and perhaps with increasing intensity. Over time the number of behaviors which need to be changed increases, with concommitant increases in the rates of occurrence of these "autonomous fights." At some point the relationship becomes so punitive that one or both members may agree to terminate it.[1]

The general approach used to intervene in such a process consists first of training members of the dyad to reduce the rate of aversive behaviors when attempting to negotiate behavior change. Video tapes of their own interaction, modelling of non-aversive negotiations, and supervised practice trials are used to bring about these initial changes. The couple are then taught to "pinpoint" the specific changes in behavior being requested. Most people

[1] Living together for extended periods of time increases the likelihood that one or both members will be placed in the position of requesting changes in the behavior of the other. This likelihood will further be increased if one member, for example, the wife, should find herself maintained on lean schedules of positive reinforcement. Consequently, high rates of responding and lean maintenance schedules of reinforcement which characterize most housework could lead to depression, anger, and repeated demands upon her husband. It is hypothesized that the overall supply of reinforcers, both social and non-social, within and outside the marriage, will correlate negatively with the rate of conflicts in married couples.

tend to use vague terms such as, "He is cold," rather than specifying, "He kisses me less than once a week," "He just never touches me," "He doesn't hug me," "He never says that he cares for me," or "He doesn't laugh very often." They are supervised as they each itemize the pinpointed behaviors relating to *one* problem. Personal communications from members of the precision teaching movement such as O. Lindsley repeatedly emphasize the importance of this step in constructing intervention strategies. E. Haughton's descriptions of some of his own innovative attempts to pinpoint and record behaviors related to adult conflicts provided a direct stimulus for incorporating the procedures here.

The couple write down the pinpointed behaviors which define, for each of them, one area in which they would like the behavior of the other person to change. They then engage in what Lederer and Jackson (1968) aptly term as "*quid pro quo*" negotiations. Having previously specified the behaviors, it is now possible to trade items. They agree to change one item of their own behavior in exchange for a change in one of the other's behaviors. At the end of this supervised negotiation, the agreement is recorded, together with the consequences accruing for not keeping the agreement. The necessity of contingency contracts was suggested by their successful application to problems of marital discord by Stuart (1969).

Three sets of criterion data were used to evaluate the outcome of the intervention. Baseline video tapes of the couple's efforts to solve their marital problems were compared to tapes obtained at the end of the training program; a code system was developed to measure changes in aversive stimuli and "problem-solving behaviors." The couple were trained to observe and record their exchanges of positive and aversive stimuli; these data were collected by daily telephone calls. The couple were also observed in their home prior to and following intervention. The prediction was made that there would be increases in their positive reinforcement and decreases in rates of aversive interactions. In addition, it was predicted that the deviant behavior of the children would decrease following intervention.[2]

PROCEDURE

Subjects

Mr. and Mrs. S had successfully participated in a child management training program to learn how to control their acting-out eight-year-old boy (Patterson, Cobb, and Ray, 1971). However, over the past three years

[2] Follow-up observations in the homes of families who have received training in child management skills suggests that the performance of these skills may be disrupted when the parents engage in severe conflict for long periods of time (Patterson, Cobb, and Ray, 1971). Presumably, reductions in parental conflict interchanges should be accompanied by reductions in rates of observed deviant child behaviors.

their marriage had steadily deteriorated to the level of frequent arguments and talk of divorce.

Mr. S had been the manager of a small company. Three months of rather sedentary courtship, consisting in the main of watching television, led to marriage. During these first years, the couple stayed at home most evenings, excepting the annual office party and an occasional movie. They had two children and an older daughter by her previous marriage.

Following a change of jobs, the financial condition of the family grew worse. This eventually resulted in a reversal of roles for the husband and wife, in that she obtained part-time employment and he spent increasing amounts of time taking care of household duties. He complained that his wife's working had led to the deterioration in the behavior of the children, to her general neglect of household chores, and to increased spending on clothes for herself. In addition, his own personal life had become very restricted and he felt increasingly alienated. She, on the other hand, spent much of her time talking and thinking about her job.

Their fights centered around her management of finances, the household, and their children. She felt that his constant nagging and sarcasm were more than she could tolerate. It had reached the point where very little that they did together was pleasant. Most often, being together signified an occasion for verbal attacks and counter-attacks. As a result, both felt distant and alienated from the other. Mr. S had suggested divorce several times in the past four months.

Criterion measures

Self-recording: During the intake interview, the couple was asked to identify those behaviors in their spouse which they found either pleasant or unpleasant and to record these behaviors each day. One of the experimenters called the S's daily to obtain these data during baseline and intervention.

During intervention the S's were also asked to record "pleasant thoughts" about each other. Wrist counters were provided for this crude effort to measure the private world of each of the members of the dyad. Presumably, successful intervention would increase the number of "pleasant thoughts" and the number of observed "pleasant behaviors" and decrease the number of "unpleasant behaviors."

Family interaction: Family interaction was observed for several months prior to training the parents to deal with their marital conflict. These data were obtained as the result of an effort to teach child management skills; the code system consisted of 29 categories of behaviors often observed in interactions among members of normal and disturbed families. The code records sequential interactions of each family member with the target person for 10 minutes; each family member serves, in turn, as the target person. The

data relevant to observer agreement, stability of estimates, effects of observer presence, and provisions for observer bias have been reviewed in previous reports (Patterson and Cobb, 1971).[3]

It was hypothesized that there would be significant increases in rate of positive reinforcement for husband-wife interactions and decreases in rates of aversive behaviors. It was also hypothesized that the rates of observed deviant child behaviors would decrease. These hypotheses were tested by comparing the two observation sessions collected immediately prior to training the parents to handle marital conflicts with the sessions made immediately following termination, and three months later in follow-up.

The Marital Interaction Coding System (MICS): The code was developed as a criterion measure to assess productive problem-solving behaviors in married couples. While there may be response classes that are peculiar to married couples, the present categories are sufficiently broad to allow the code to be used for a variety of problem-solving groups of various sizes. Presently, it consists of 29 response classes which are recorded in a sequential pattern in 30-second intervals so that the pattern of dyadic interchange is not lost. The categories were based in part upon an earlier code for family interaction which was modified to include the verbal responses observed in videotapes of married couples attempting to negotiate changes in one another's behavior.

During the videotaped observations, two specific behaviors became readily apparent. First, the couples spent considerable time talking about the problem in a general way, but failed to be specific in making suggestions for change. Consequently, three codes were added: Problem Description (PD), which refers to any statements pertaining to the problem without any suggestions for change, Problem Solution (PS), referring to a statement which suggests or proposes a change which could lead to a solution of the problem; and Compromise (CS), which involves a mutual exchange of behaviors leading toward the solution of the problem.

Secondly, it was noted that few people were particularly skilled at maintaining the focus of their interaction on the problem. Most discussions tended to digress in a variety of ways and to a variety of different subjects. Even when both members of the dyad initially agreed on the problem they were attempting to solve, very soon one of the members would change the topic. Spouses would add irrelevant materials, interrupt the speaker, or when faced with a complaint, introduce a countercomplaint of his own, so that very soon the discussion was centered around issues completely irrelevant to the problem at hand. Such attempts at digression led to the formulation of a number of categories to record such side-tracking behavior: any change

[3]To order the code manual, contact ASIS National Auxiliary Publications Service, c/o CCM Information Sciences, Inc., 909 Third Avenue, New York, New York, 10022. Request document 01234; remit $2.00 for microfilm or $5.30 for photo copies.

in the content area was duly recorded; Excuse (Ex) referred to a denial of responsibility by invoking implausible explanations or spurious reasons; Complaint (CP), a statement expressing a person's suffering, almost always delivered in a whining tone; and Interrupt (IN) was used whenever a person interrupted the speaker's attempt to make a statement.

The coding manual containing operational definitions for each category and the procedures for coding is available (Hops, Wills, Patterson, and Weiss, 1971). The code system at present includes the following categories:

AG Agree	DG Disagree	PD Problem Description
AP Approval	DR Deny Responsibility	PP Positive Physical Contact
AR Accept Responsibility	EX Excuse	PS Problem Solving
AS Assent	HM Humor	PU Put Down
AT Attention	IN Interrupt	QU Question
CM Command	LA Laugh	SM Smile
CO Compliance	NC Noncompliance	SP Solution (Past)
CP Complaint	NO Normative	TA Talk
CR Criticize	NR No Response	TO Turn Off
CS Compromise	NT Not Tracking	

Each videotape was coded by two judges. Their agreement between each 30 seconds of interaction was calculated. Coder reliability was established as the frequency of behavioral events in which both judges agreed in specifying the response class as well as the order in which they occurred, divided by the total number of events observed. The median for the distribution of agreements for coding the interaction of the S couple was .76 with a range of .72 to .78.

Intervention procedures

A basic assumption of the method was that couples can be trained to negotiate changes in each other's behavior. The techniques involved training in observing, specific pinpointing of behaviors to be changed, setting consequences for failure to comply, and recording agreements in written contracts. The training took place in the laboratory where videotapes of their interactions could be presented to them. During these playbacks, they were trained to discriminate among effective and ineffective problem-solving behaviors. The experimenters modelled the appropriate discriminations and provided social reinforcers contingent upon accurate performance in responding to the tapes. The experimenters also role-played more effective problem-solving behaviors, taking the part of either or both in modelling each specific skill. The husband and wife then imitated the performance and videotapes of their behavior were played back to them. In the training particular emphasis was given the labelling and eventual deceleration of such behaviors as criticism, excuses, unwillingness to accept responsibility for past behavior, or side-tracking during problem-solving.

In the first session, the intake interview, a history of their marital and

pre-marital interaction was obtained. In addition, a particular attempt was made to elicit information about those events which each found to be reinforcing or aversive. The couple was informed of the experimental nature of the procedures and told that should they desire to terminate, at any time, the investigators would arrange for other treatment to be made available. Nine weekly sessions, plus the daily telephone calls (approximately three to five minutes each) comprised the total intervention.

The general format required that the couple "earn" the experimenters' time by performing several tasks each week. Each meeting began by requiring that each of them give a five-minute lecture of reading material assigned that week from Lederer and Jackson (1968). In addition to experiencing contingency contracts, the information and procedures contained in the reading materials provided a general understanding of the training procedures and would presumably increase the generalization of training results. It was also necessary for them to have provided consistent data during the preceding week in order for them to earn the training session. On only one occasion was it necessary to delay a training session because a contingency had not been met.

During a baseline session Mr. and Mrs. S were asked to "solve" one of their conflicts; their interactions were videotaped and replayed. The concept of aversive stimuli leading to side-tracking was explained to them and they were then asked to tabulate the frequency of such aversive events as: criticism, ridicule, sarcasm, changing the subject, or denial occurring for each of them. Following this, the two experimenters role-played an interchange which focused upon the same problem the subjects had dealt with. The modelled interchange was non-aversive, behaviors were carefully pinpointed, and a trade was negotiated within a period of minutes. When the subjects were then asked to go through the same performance, their interchanges were noticeably less aversive, however, it was clear that they still lacked a necessary skill. The skill seemed so simple that we had not thought to particularly emphasize it. They simply could not be specific and pinpoint what the behavior was that ought to be changed in the other person.

In observing Mr. S, he seemed incapable of being specific and stood for a long time at the chalkboard while he considered what behaviors emitted by his wife really bothered him. After much temporizing and several statements to the effect that she was so perfect that really there was nothing she "had" to change, he finally wrote, "her work." This does not, of course, meet Ogden Lindsley's criterion for "pinpoint." There is little in the statement "her work" that specifies *what* it is that his *wife* should change. Three weeks later, after much further practice in pinpointing, the husband was able to record, "coming home after 4:30 from work," "working on weekends," and "spending all of the money she earns on herself." These statements *are* pinpointed behaviors. Their apparent difficulty in carrying out this simple task was a complete surprise to us.

The following sessions were spent in teaching the couple how to be specific in their complaints and in their suggestions for change. These communications were exchanged without interruptions from the other. Lists of these complaints were placed on the board. On each trial they were reinforced for being *specific*; ambiguous complaints were so labelled. The fact that they no longer side-tracked each other facilitated this part of the training.

In the next session, the S's were asked to negotiate changes in each other's behavior from the list they had made. They were taught not only that compromises were to be made, but also that consequences should be set, both for successful completion of the contract, and for failure to comply with the terms of the agreement. Pinpointing, negotiating, and setting up contracts became the *modus operandi*.

The following is their first contract. Others are included in Appendix A. It should be noted that all the pinpointed items are deceleration targets, that is, high rate behaviors which are highly aversive.

Agreement No. 1

Betty's request for changes in Bill:

1. Discuss money only once a week for about 15 minutes.
2. Nag only once a month.
3. No nagging about the job unless the routine is changed.

Consequence: If he slips up and does more nagging than agreed upon, then Betty can buy a dress on the household account ($20.00). However, if he nags more than three times in the week, this is not a down payment on a $100 dress.

Bill's request for changes in Betty:

1. No deviations from the present work routine. At present, this includes: M, 9-5:30; Tu, 5-9; W, off; Th, 5-9; F, 9-1; no Sat or Sun. Consequence: If the routine is broken, i.e., Betty comes home after the specified hours or works on a weekend, it will cost her $5 from her personal checking account.
2. When Bill can afford to give Betty $100 per month for herself then she quits working.

________________ ________________

Betty Bill

In order to aid in generalization of the successful problem-solving activities from the office to the home, Mr. and Mrs. S were asked to negotiate other contracts at home, after specifying the requests for change under the watchful eyes of the experimenters. The first attempt was somewhat unsuccessful. Mrs. S wrote up the contract by herself, and then gave it to her husband for his approval. Prior to further negotiation, they were instructed that both must be simultaneously involved in the activity, otherwise the benefits were minimal.

The total amount of professional time required was 19 hours. This included the intake interview, telephone calls, and the presence of two experimenters at most of the intervention sessions.

RESULTS

It was hypothesized that the effect of the skill training program would be reflected in criteria data obtained in both the laboratory and the home. Presumably, the coded interactions occurring in the laboratory would demonstrate significant decreases in rates of aversive behaviors exchanged by both partners. It should also increase rates of behaviors which facilitate problem-solving.

To the extent that increases in these skills generalize to the world outside the laboratory, the changes should also be reflected in increases in "pleasures" and decreases in "displeasures" recorded by each member in describing the daily behaviors of the other. The husband-wife interactions should become less punishing and more reinforcing, accompanied by observed reductions in rates of deviant child behaviors.

Changes in problem-solving skills

During baseline one videotape was made of the couple's attempts at negotiation; during intervention three more were made. Codes were grouped, *a priori*, into three classes in terms of their presumed effect upon problem-solving: Level I included Problem-Solving, Accept Responsibility, and Compromise; Level II included Problem Description and Past Solutions (while related to the problem, and perhaps necessary to some degree, they are assumed to be less facilitating to a successful outcome than are Level I behaviors); Level III consists of those response classes which are both counter-productive and highly aversive. They tend to produce side-tracks rather than achieve resolution: Complaint, Criticize, Deny Responsibility, Excuse, Put Down.

The mean rates per minute dispensed by husband and wife for each Level for baseline and intervention are presented in Table 11-1.

The data for each Level were subjected to an ANOVA repeated measures. The *F* values refer to the main effects by sessions changes. The details for the analyses are presented in Appendix B.

The data showed significant changes in all Levels of problem-solving skills. There were large increases in rates of effective problem-solving behaviors and moderate decreases in behaviors which are presumably only tangentially relevant or disruptive of problem-solving. These findings provide major support for the hypothesis that the training procedures altered the behaviors for which they were designed. The behavior of the

Table 11–1. Changes in problem-solving skills in the laboratory

Level	Mean Rates Per Minute Agent	Baseline	Treatment Sessions 1	5	6	F (Sessions)
I Problem-Solving, Accept Responsibility, Compromise	Wife	.00	.90	1.88	2.20	6.87***
	Husband	.62	1.50	1.63	1.60	
II Problem Description, Past Solution	Wife	1.69	2.80	1.75	1.27	3.13*
	Husband	3.54	1.50	1.13	1.47	
III Side-Track	Wife	.92	.30	.38	.38	3.63*
	Husband	.62	.00	.13	.07	

***$P < .001$. *$P < .05$.

couple in the laboratory was indeed altered. The practical implications of these changes depend upon demonstrated changes in interactions occurring within the home.

Generalization to interaction in the home

Observation in home: Baseline observations of family interaction were obtained one month prior to the beginning of the laboratory studies, at termination of training in parent negotiation, and three months following intervention. All probes consisted of two home observation sessions.

Based on an earlier analysis of sequential interactions in families of aggressive boys, 14 code categories have been identified which serve to decelerate on-going pro-social behaviors (Patterson and Cobb, 1971). This effect constitutes an operational definition of what is meant by "aversive behaviors," at least in the context of family interaction.[4] The frequency of data was tabulated separately for each family member and divided by the total number of minutes for which observation data were available.[5] The mean rates for baseline, post-intervention, and follow-up are summarized in Table 11-2 below.

The data showed that there was in fact an overall improvement in the quality of family interaction following the training for negotiation skills. However, the Friedman analysis of variance showed these trends to be non-significant. While the father seems to have demonstrated marked reductions in his aversive behavior, as did the previously identified problem child, the

[4] The family interaction code categories which meet this requirement and were therefore included in determining the total aversiveness scores were: Whine, Yell, Tease, Hit, Cry, Ignore, Humiliate, Negativism, Noncomply, Destructive, Dependency, and Negative Command.

[5] Data were not included for the two-year-old sibling. Prior analysis has shown that for some reason, parents do not make an energetic attempt to apply child management skills to three- or four-year-old children.

Table 11–2. Changes in aversive family interaction

Agent	Mean Rate Aversive Behavior Baseline*	Post-treatment	Follow-up
Mother	.4	.6	.4
Father	.7	.1	.0
Targeted Child	.5	.3	.3
Mean	.53	.33	.23

* Data collected one month prior to Baseline for Laboratory study.

mother showed no improvements in her interactions. The fact that the trends for the family's "aversiveness" were non-significant would suggest some limitations in generalization from the laboratory training to the home.

There are several respects in which family interactions could alter and provide support for the generalization of effects. If a high proportion of interaction is involved in the exchange of aversive behaviors, then it seems likely that the members would tend to either avoid interactions or to escape as quickly as possible. In either case, this should result in interactions of relatively limited duration for all concerned. Reduction in rates of aversive behavior or increases in exchange of positive social reinforcers would likely be accompanied by increases in duration of interaction episodes. This type of effect had previously been obtained in a family intervention study in which both the mother and the child had been trained to increase their use of social reinforcers. This type of training was followed by dramatic increases in duration of interaction episodes (Patterson, McNeal, Hawkins, and Phelps, 1967).

Interactions between husband and wife were tallied for duration of the interchanges. These data are summarized in Table 11–3.

These data showed that the median duration of interaction was from six to 12 seconds during the baseline observations in the home. During treatment the median duration was somewhere in the 25- to 36-second range. The extended duration of interaction was maintained during follow-up. The chi square value of 95.67 for the three by four table was significant and p less than .001, and offers strong support for the assumption that generalization of training effects had occurred. While only limited changes in aversiveness among family members had been demonstrated, the present analysis suggests additional changes in family structure which were not covered in this approach.

Table 11–3. Duration of husband-wife interaction

Duration	Baseline	Post-treatment	Follow-up
6 to 12"	.51	.33	.14
13 to 24"	.49	.09	.33
25 to 36"	.00	.27	.29
greater than 36"	.00	.31	.24

Self-report data

An attempt was made during the intake interview to encourage each spouse to list specific behaviors in the other which either pleased or displeased them. Unfortunately, the lists provided contained only three or four behaviors; most of them, rather low rate in occurrence.[6] The husband characteristically provided only one or two "Please" and "Displease" events each day during baseline and intervention. The wife increased her rate from an average of .5 "Pleases" and "Displeases" each day during baseline to one or two responses during intervention.[7] Our impression was that the couple recorded only the most gross episodes and that their reporting for even these events was inaccurate. For example, the husband "forgot" to collect his first week's baseline data; both members forgot to record data during a prolonged honeymoon period at the beach that occurred in the middle of intervention.

Because of the difficulties in recording "Pleases" and "Displeases," an effort was made to obtain an additional measure of satisfaction with the interaction. The couple recorded each occasion during the day that they "had a pleasant thought" about the other. Mrs. S showed a mean of 1.6 such thoughts per day throughout the study period. However, Mr. S showed an increase from 1.8 such thoughts per day during the early phases of intervention to 2.7 responses during the last phases. These data suggested that the husband changed more than did his wife. This is of interest because it corresponds with the data on the observed changes in their rates of aversive behaviors in the home. Correlational analysis showed that the rates of "pleasant thoughts about the other" did not covary for the husband and wife.

There are many unknowns attached to these kinds of self-report data. However, because of the obvious relevance which such data could have in evaluating intervention outcomes, further methodological studies are being carried out.

[6] Couples now being seen are given a checklist of "Pleases" and "Displeases" which contain close to a hundred events noted by other couples as belonging on either list. The list serves as a valuable prompt both in constructing the original lists for a couple, and for obtaining the daily reports.

[7] Because of our general interest in exchange theories, it was of some interest to determine whether these variables covaried over time. Spearman rank order correlations were computed for Mrs. S' recording of "Pleasures" and "Displeasures" over the 25 days of data collecting. The correlation was .05. However, the comparable correlation for Mr. S' data was .45 (p less than .05), suggesting that on the days that he recorded high rates of "Pleasures," he also reported high rates of "Displeasures." The rank order correlation between "Pleasures" for Mr. and Mrs. S was not significant; however, the analysis for "Displeasures" showed a correlation of .55 (p less than .02). There did seem to be an equity in the dispensing of pain. This is of some interest in that it supports a finding by Reid (1967) which showed that among family members, those individuals who dispensed aversive stimuli were not likely to receive aversive behaviors from others. This relation was expressed in a correlation of .65 and was considerably higher than the correlation describing reciprocity for positive reinforcers.

SUMMARY

A couple was trained to pinpoint behaviors which they desired to be changed in their partners. They were then supervised in the laboratory as they negotiated "trades" for pinpointed behaviors. Finally, they constructed contracts that specified pinpointed behaviors, exchanges, and consequences for failure to live up to the agreement. Observation of videotaped interactions in the laboratory showed significant changes in problem-solving skills.

Observation data collected in the home showed that the aversive behaviors decreased for the father and a problem child, but not for the wife. The duration of interaction episodes increased following intervention, presumably showing the generalization of effects from training in the laboratory. Attempts to demonstrate generalization by using self-report data were not successful.

This small pilot study demonstrates that, in principle, it may be possible to teach problem-solving skills that will reduce marital conflict. The training program itself seems replicable, and the several sets of criterion data seem plausible. At the present time further exploration is under way.

APPENDIX A

Agreement No. 2

Comes now the Plaintiffs and for cause of action against the Defendents, complains and alleges as follows:

I.

That the Defendant, Bill, does not and will not cease from hanging clothes on bed posts and the valet.

That the Defendant, Betty, does not and will not place her shoes on her shoe rack when coming home from work.

Therefore, the Defendant, Bill, shall pay to the Plaintiff, Betty, the amount of $5.00 for each article of clothing placed on the above named particulars. Also, the Defendant, Betty, shall pay the amount of $5.00 to the Plaintiff, Bill, for each pair of shoes not placed on the proper shoe rack.

II.

That the Defendant, Bill, does throw newspapers about the floor when finished reading.

That the Defendant, Betty, does leave dinner dishes overnight without reason.

Therefore, the Defendant, Bill, violating the above shall mop the floor and/or wash the windows for not less than three (3) days.
Also, the Defendant, Betty, violating the above, shall wash the Volkswagen and clean interior.

III.

That the Defendant, Bill, does not and will not replace shaving materials after using.
That the Defendant, Betty, does not keep her bathroom neat from cosmetics, etc.
Therefore, the Defendant, Bill, violating the above, consents to the Plaintiff, Betty, to put such materials into hiding place for not more than three (3) days.
Also, the Defendant, Betty, violating the above, must consent to the Plaintiff, Bill, to put such articles into hiding place for not more than three (3) days.

IV.

That the Defendant, Bill, does not and will not place his dirty dishes into dishwasher and the supper dishes on nights when wife works.
That the Defendant, Betty, does not and will not keep her dressing table neat from panty-hose and other various undergarments.
Therefore, the Defendant, Bill, violating the above, shall do dishes and keep the kitchen clean for not less than and not more than four (4) days; allowing Plaintiff, Betty, to dirty as many dishes as she sees fit.
Also, the Defendant, Betty, violating the above, shall become a complete servant to the Plaintiff, Bill, doing for him whatsoever he asks of her that is reasonable for not more than and not less than four (4) days.

I shall hereby carry out all of the above consequences for the alleged violations.

SIGNED ______________________

Bill, Plaintiff and Defendant

SIGNED ______________________

Betty. Plaintiff and Defendant

Agreement No. 3

Spending more time alone; Bill by playing golf and Betty will get baby-sitter and do her thing alone. (Spend some time with her friends). This shall occur not more than once a week. If one party

chooses not to do his thing, this is all right. But, on the other hand, if the other party chooses to do his or her thing, he or she may. If Bill chooses to do something other than golf, he may do whatever he wishes. This shall be strictly during the daytime.

Spending more time together by taking weekend trips not less than three times a year. Betty shall see that proper arrangements are made for the children. A time shall be set for this and if one party refuses to go at this time, the consequences will be that the dissenting party will have to sacrifice his or her time alone (as in paragraph I). It is all right if both parties agree not to go at the planned time.

Bill has permitted Betty to work more hours, provided she does not work more than two nights a week and no weekends, or perhaps one half-day on Saturdays. This has to follow a stable schedule during the week. The consequences are $5.00 for every time she works an irregular schedule. If Bill harrasses Betty during a normal routine in schedule, then he owes her $5.00.

SIGNED ______________________

Bill

SIGNED ______________________

Betty

APPENDIX B

Table 11-4. Repeated measure analysis of variance for changes in mean rates of level I problem-solving behavior

Source	SS	df	MS	F	P
Treatment	27.63	3	9.21	6.87	<.0001
Spouse	.01	1	.01	<1	n.s.
Interaction	7.60	3	2.53	1.89	n.s.
Error	96.15	72	1.34		
Total	131.39	79			

Table 11-5. Repeated measures analysis of variance for changes in mean rates of level II problem-solving behaviors

Source	SS	df	MS	F	P
Treatment	17.85	3	5.95	3.13	<.05
Spouse	.05	1	.05	<1	n.s.
Interaction	19.99	3	6.66	3.51	<.025
Error	136.91	72	1.90		
Total	174.80	79			

Table 11-6. Repeated measures analysis of variance for changes in mean rates of level III problem-solving behaviors

Source	S	df	MS	F	P
Treatment	4.58	3	1.53	3.63	<.025
Spouse	.45	1	.45	<1	n.s.
Interaction	.57	3	.19	<1	n.s.
Error	30.35	72	.42		
Total	35.95	79			

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12

SOCIAL ORGANIZATION

When the behavior of a group of animals is viewed as a whole, patterns of behavior emerge. Certain animals may repeatedly behave in unison. Other animals may repeat the same aggressive, competitive, cooperative, or mutually reinforcing behaviors. The multitude of social contacts between individuals in a group seems to form discriminable concepts which in themselves act to control behavior. Within the group, certain animals that have sustained and frequent contact with one another are regarded as subunits or subgroups of the overall group or society. The individual's behavior is controlled, in part, by his history of membership in various subgroups. The individual's relationship to the group—his *status*—may be defined in terms of patterns in his behavior. These patterns of behavior are perceived by and influence the behavior of other members of the group. Thus an individual's current social experience is in part determined by the complex discriminative social stimuli created by his past experience. All of the discriminable patterns of social behavior among group members combine to form the social organization of the group. This chapter will attempt to describe some traditional social organizations in behavioral terms and to examine some of the experiences which determine an individual's status in a group.

The forms of social organization that typically emerge from the group behavior of individuals serve a variety of functions. One is to maximize reinforcement for group members by making social relationships more efficient. In highly-structured human societies, such as the traditional societies of India and China, many behaviors of individuals are predictable from their status in the society. Much of current social interaction is regulated by the discriminative stimuli associated with the individual's status. One person knows how to speak to another, what food the other person will eat, and generally what reinforcers and behaviors to expect from that person. In such societies, unstable social relationships are minimized since potential sources of instability are reduced by the control that the social organization has over behavior. If two people cooperate in such a society, each knows what

behaviors to emit and what reinforcers to expect. The reinforcement responsibilities of each member in a relationship of mutual reinforcement are delineated. An Indian of the sweeper caste knew exactly what reinforcers he "owed" his employer in the form of services. In addition, he knew exactly what reinforcers his employer "owed" him, down to the amount and type of leftover food and discarded clothing (Beals, 1963). American society is much less structured. To a greater extent, each social encounter must be approached without the extensive discriminative stimuli associated with status. New discriminative stimuli must be learned, which may apply only to the current relationship. A secretary applying for a job knows within certain limits what behaviors might be expected of her and what compensation she might receive. The details must be resolved by an interaction between herself and her potential employer. When two Americans meet informally, very few of the discriminative stimuli associated with status are available to structure the interaction. The less rigid social order of American society sacrifices efficiency for the sake of flexibility. Indeed, the rigid traditional structures of China and India have ultimately proved ineffective in meeting the changing demands of the modern world.

Another function of social organization is to regulate the distribution of reinforcers such as food, living space, sexual gratification, and sexual contact. The distribution of reinforcers effected by social organization is seldom equitable. However, the distribution is usually stable and usually in the interests of the survival of the group. The function of social organization in distributing reinforcers can be seen in the types of social organization common in nonhuman groups. One type of social organization is centered around territory. In many species, each animal or mating pair of animals controls a certain territory. Initial aggressive encounters determine the territories. Once a territory is acquired, the animal is more likely to win aggressive encounters within it. Thus the animal generally holds his territory and has access to whatever reinforcers it contains (Andrew, 1956; Carpenter, 1958; Ficken, 1962; King, 1955; Scott, 1944).

The most typical social organization among animals depends on dominance. The prototype for this social organization is the peck order which forms in groups of chickens (Guhl, 1956). The status of individuals is conceived in terms of their rank within the group. Initial aggressive encounters determine the rank of each individual relative to the other members of the group. In chickens the rank order is usually linear: the highest ranking bird, called the alpha bird, ranks above all others. The second-highest ranking bird, the beta bird, ranks above all except the alpha bird. Occasionally anomalies may occur in the order. Bird number 5 may dominate birds, 6, 7, 9, and 10, but be dominated by bird number 8. In social orders based on dominance, high-ranking members have first access to reinforcers. High-ranking males have

first access to females. In competitive encounters, the higher-ranking animal will obtain the reinforcer, usually by threatening the other animal with the behavior that precedes overt aggression. High-ranking members may threaten and aggress against lower-ranking members without retaliation. Social orders based on dominance provide a method for distributing reinforcers. From the point of view of lower-ranking members, the system obviously is not too equitable; however it does provide stability. Guhl and Allee (1944) found that hens in organized flocks weighed more and produced more eggs than hens in flocks undergoing constant reorganization. In groups with a stable social organization, each instance of competition need not be decided separately; the results of prior competition and aggression generalize to new encounters. The group thus functions more efficiently with less disruption from competition over limited resources (Allee, 1942; Grant and Chance, 1958; Guhl and Atkeson, 1959; Maslow, 1934, 1936; Pardi, 1948; Scott, 1945).

Although aggressive behavior is important in establishing nonhuman social organization, the organization itself tends to lessen aggression. Situations that would occasion overt aggression between two "strangers" seem to be settled on the basis of status, perhaps reinforced by threat. The chicks studied by Ratner (1965) are typical. Immediately after chicks reared in isolation were combined in a group, a flurry of aggression occurred. The aggression established the "peck order" that led to a subsequent decrease in aggression.

Social organization has an effect on the genetic legacy of the group. In social organizations based on dominance, high-ranking individuals are more likely to survive such situations as food shortage and live to reproduce. High-ranking males have first access to females and are far more likely to contribute to the gene pool. In fact, Guhl (1956) reports that, in a group of chickens, the lowest ranking male failed to fertilize even one egg. However, in many groups, lower ranking females are more likely to reproduce. The aggressiveness that enables a female to achieve a high rank may interfere with sexual behavior (Guhl, 1956; Woolpy and Ginsburg, 1967). Nevertheless, social organizations, especially those based on dominance, do in general favor reproduction of higher-ranking members.

The fact that social organization usually promotes group stability and survival does not explain the behavior of the individuals in the group. An individual does not take its place in the organization of the group in order to promote group tranquility or influence the group's gene pool. The individual's behavior must be controlled by the reinforcing and aversive stimuli known to control behavior. The papers presented in this chapter demonstrate behavioral mechanisms that may be responsible for the behavior of individuals as it appears in social organization.

The first paper presented, by S. C. Ratner and entitled, "Effect of learning to be submissive on status in the peck order of domestic fowl," studies the effect of aversive stimuli on the status of birds in a typical peck-order social organization. Ratner first determined the existing peck order in four groups of chickens. Eight experimental birds were selected from the middle ranks of the groups. Each of these birds was given a series of encounters with a highly aggressive bird, which Ratner terms a despot. The birds were then returned to their groups and the peck order redetermined. When returned to their groups, all but one of the birds had descended in the hierarchies. The bird whose rank was most reduced was judged to have had the most aversive experience with the despot. Also, the one bird who had not been completely submissive to the despot actually gained in rank. The peck orders of chickens are usually stable. The changes effected in the experimental birds' status by their experience with the despot suggest that losing in aggressive encounters may be one type of experience responsible for the status of lower-ranking members of the group. Ratner suggests that his results can be explained by generalization of the experience with the despot to the birds in the home group. Punishment by the despot, presumably of aggressive and non-aggressive behaviors, may have made the birds more likely to avoid encounters with other animals. Such avoidance behavior is characteristic of lower-ranking members of the peck order. The avoidance behavior may have provided discriminative stimuli that made aggressive behavior by other group members more likely. The experimental birds were attacked more, they avoided other group members more, and they descended in the social order.

When peck orders form, winning or losing in initial encounters is probably crucial in determining the rank of an individual. The factors that determine winning or losing in initial encounters are not elucidated by the work presented here. Factors such as greater comb size (Collias, 1943), greater body weight (Collias, 1943), greater age (Collias, 1943; Hutchinson, Ulrich, and Azrin, 1965; Ratner and Denburg, 1959), and higher levels of sex hormones (Hutchinson, Ulrich, and Azrin, 1965; Levy and King, 1953) may make winning more likely. Details of the aggressive encounter, such as one bird striking when the other's attention is distracted, may also influence the outcome. Nevertheless, Ratner's work shows that defeat in aggressive encounters, regardless of the identity of the winner, does seem to reduce social rank.

The second paper presented in this chapter also examines the role of aversive stimuli in determining social status. The paper, by R. E. Miller, J. V. Murphy, and I. A. Mirsky, is entitled, "The modification of social dominance in a group of monkeys by interanimal conditioning." As in Ratner's study, Miller, Murphy, and Mirsky first determined the existing hierarchy in a group of monkeys. Then a low-ranking monkey was selected to act as a discriminative stimulus in a standard avoidance procedure. Other animals from the group

were selected to serve as avoiding animals. When the stimulus animal was made visible, the avoiding animal was allowed five seconds to pull a bar that would inhibit delivery of a shock. Pulling the bar after onset of shock terminated the shock. After seven eight-day sequences of avoidance training, over the course of fourteen weeks, the status of the stimulus monkey was raised from eighth to fourth in the group of ten. Apparently the avoidance response of the conditioned monkeys transferred from the experimental situation to the group situation and from the experimental avoidance response to other, "natural" avoidance responses. In addition, the behavior of the stimulus monkey changed. The stimulus monkey dominated not only the monkeys conditioned to avoid him, but other monkeys as well. Perhaps the avoidance behavior of the conditioned monkeys provided stimuli that altered the behavior of the stimulus monkey, not only toward the conditioned monkeys, but also toward other monkeys.

A similar result was obtained by Radlow, Hale, and Smith (1958) using chickens as subjects. The aversive stimulus was a shock delivered through wires attached to the wings of the alpha bird in a five-bird flock. A piece of grain was dropped between the alpha bird and a stimulus bird. The alpha bird was shocked if it attacked the stimulus bird. Each of the birds in the flock eventually served as a stimulus bird. After conditioning, the experimental bird dropped from first to last in rank in the flock.

A high rate of avoidance behavior is an important component of lower social status in social organizations based on dominance. This avoidance behavior is apparently created when other animals in the group become discriminative for the presentation of aversive stimuli. Avoidance conditioning, even in a restricted setting, can have far-reaching effects, not only on the behavior of the conditioned animal, but also on the behavior of animals with which the conditioned animal interacts.

Nonhuman animals frequently live in small groups. When the organization of those groups is based on dominance, the status of the various group members is easy to discern. Dominant animals are aggressive and have first access to reinforcers. Lower-ranking animals avoid encounters with higher-ranking animals and defer reinforcement to their superiors. The organization of human groups is less simple. Kinship is far more important in human groups. Small, primitive groups are often organized chiefly along kinship lines (Service, 1962). A family, including aunts, uncles, cousins and grandparents, as well as parents and siblings, may live together. Relationships are well-defined within the family group. Within the general group, the individual's status may be determined according to his age, sex, or the status of his family group. Even far-reaching, highly developed cultures, such as the traditional culture of China, may be organized to a large extent on the basis of kinship.

In some large, complex human social groups the social organization may be fairly obvious. The traditional caste system of India, as already mentioned, is an example of a strong, clear-cut social organization existing in a complex, human society. Landlord systems, such as the manorial system of medieval Europe and the *jajmani* system of India, often characterize well-developed agrarian civilizations. The status of individuals within such societies may be easily determined, and their behavior may to a large extent be predicted from knowledge of their status in the various social groups in their society.

The social organization of modern Western civilization is far less easy to describe. Attempts have been made to describe the organization of American society in terms of a stratified social class system. The classification may be based on income, type of employment, place of residence and education (e.g. Myers and Roberts, 1959, pp. 24–26). Many high-income, college-educated, professional residents of suburbs exist in American society. However, there are many anomalies. A teacher in a city school may be a low-income, college-educated professional who lives in a typically lower-class neighborhood. Also, the social mobility of American society makes classification of many individuals impossible. A person starting a business may become a high-income, uneducated suburbanite, or he may become a low-income, uneducated dweller of a poor neighborhood. The behavior and dress of Americans is similar, and the differences that exist do not often coincide with class lines. In traditional India the status of a person could be ascertained at a glance. In America, considerable contact with the person is necessary.

In groups of animals, status is determined by success in aggressive encounters and by access to reinforcers. Status in rigid, stratified human societies has a similar flavor. If a conflict of interest arose between a member of an Indian sweeper caste and a landowner, the wishes of the landowner would prevail. Similarly, a traditional Chinese son would defer to his father. As social organization becomes more flexible, status can no longer be defined simply in terms of competition over reinforcers. Lower-caste Indians are now making nontraditional demands on their employers (Gough, 1955, p. 47). The employers continue to have the higher status, yet their interests are not always served. In the United States, if a middle, and an upper-class man apply for the same job, the middle-class man is not likely to defer to the upper-class man. However, a corporate vice president will usually defer to the president.

Status in modern Western society is a complex concept based on a number of stimulus properties and behaviors. As already mentioned, high-status individuals are often those who obtain reinforcement in competitive situations. To some extent, the status of a person may be generalized from the status of others, such as his parents or the person he marries. A Rockefeller would be regarded by many as upper class regardless of his behavior. Other stimulus

properties such as sex or race may determine status. One important factor appears to be control of discriminative stimuli that maximize reinforcement both for the high-status individual and for group members. High-status individuals seem to control the discriminative stimuli and often the reinforcers important in leadership as defined in Chapter I, and in authority as defined in Chapter 2. The "boss," as a leader, provides the discriminative stimuli which make production and reinforcement possible both for the worker and the boss. The boss, as an authority, presents discriminative stimuli that control the behavior of employees, which behavior he must also reinforce. The behavior of a lower-status person toward a higher-status person is often not so much to defer reinforcement to him, but to respond to the stimuli he controls. Finally, one aspect of status in human societies seems to be the receipt of many positive reinforcers, such as money. The high-status person is frequently one who is able himself to behave effectively to obtain conspicuous reinforcers.

The third paper presented in this chapter studies the relationship between reinforcement and status in four-person groups. The paper is by S. M. Zdep and W. F. Oakes, and is entitled, "Reinforcement of leadership behavior in group discussion." The experimental arrangement is reminiscent of that used by Simkins and West (1966) to study verbal interaction in a small group. An individual reinforcing and punishing mechanism was visible only to each subject. However, the subjects were able to see one another. The subjects were asked to discuss "human relations problems." The reinforcers and punishers were lights that indicated whether the individual's behavior facilitated or hindered group processes.

After an initial, baseline discussion of one problem, the subjects in half the groups were given a questionnaire asking them to rank all participants on the following items: "(a) Who would you say was the group's leader? (b) Who would you say talked the most? (c) Who would you say had the best ideas? and (d) Who would you say did the most to guide group discussion?" Discussion of a second problem followed. During the second discussion, the subject ranked third on the questionnaire or third in amount of time previously spent talking was selected as the target person. In half the groups the target person was reinforced for talking and punished for not talking. The nontarget persons were reinforced for agreeing with the target person and punished for expressing opinions and excessive verbalization. In the other half of the groups, no reinforcing or punishing lights were used. Thus one-fourth of the groups received the reinforcing and punishing lights. One-fourth of the groups received the questionnaire but not the lights. One-fourth did not receive the questionnaire, but received the lights. One-fourth received neither the questionnaire nor the lights. After the second discussion all subjects received the questionnaire. The questionnaire was then followed by a discussion in which none of the subjects received the lights.

The lights not only increased the talking time of the target persons, but also increased their status as ranked on the questionnaire. Administration versus nonadministration of the questionnaire between the baseline and the experimental discussions had no significant effect. The authors felt that "talking the most" was not a part of the concept of status. However, all four of the questionnaire items covaried. Indeed, a high rate of acceptable behavior may be one of the factors contributing to the concept of status in human social groups. Reinforcement of an individual's behavior may create the high rate which in turn contributes to status. In fact, the only facet of the target persons' behavior that was manipulated in the study was their rate of talking. The content of the verbal behavior may have changed to give the impression that the target person was the leader, or that his ideas were best. However, judgments of leadership or quality may have been influenced most significantly simply by the increase in the rate of talking.

The papers included in this chapter suggest that aversive experiences that involve punishment or avoidance of social behaviors tend to decrease status. On the other hand, experiences that involve the positive reinforcement of behavior acceptable to the group tend to increase status. Such generalizations are of little use in predicting the behavior of individuals, since punishment of behaviors associated with high status or reinforcement of behaviors associated with low status could have the opposite effect. However, reinforcement or punishment in one behavioral context does seem to have a striking and far-reaching influence on many social behaviors of the individual in the group.

The view of social behavior presented in this book has emphasized the behavior of individuals as it occurs in social situations. Little attempt has been made to treat social groups themselves as entities with behavior of their own. Yet social behavior is often approached at the level of group behavior. Unions, universities, governments, and armies are actually groups of individuals behaving in certain patterns. At the same time, these large groups seem themselves to have a unified "behavior" that can be controlled by factors internal and external to the social group. Skinner (1953, pp. 297–298) has made this point:

> Many generalizations at the level of the group need not refer to behavior at all. There is an old law in economics, called Gresham's Law, which states that bad money drives good money out of circulation. If we can agree as to what money is, whether it is good or bad, and when it is in circulation, we can express this general principle without making specific reference to the use of money by individuals. Similar generalizations are found in sociology, cultural anthropology, linguistics, and history. But a 'social law' must be generated by the behavior of individuals. It is always an individual who behaves, and he behaves with the same body and according to the same process as

> in a nonsocial situation. If an individual possessing two pieces of money, one good and one bad, tends to spend the bad and save the good—a tendency which may be explained in terms of reinforcing contingencies—and if this is true of a large number of people, the phenomenon described by Gresham's Law arises. The individual behavior explains the group phenomenon. Many economists feel the need for some such explanation of all economic law, although there are others who would accept the higher level of description as valid in its own right.

Large institutions are comprised of individuals, and the behavior of the institutions is composed of myriad small elements of social behavior at the level of each individual. A complete understanding of the organization and functioning of large groups requires an understanding of the factors that control the behavior of the individual group members. Social and nonsocial stimulus conditions mold the behavior of individuals into patterns that in themselves may create stimulus conditions. When a group behaves, many individuals act together to produce a discernible result on a grand scale. The behavior of large numbers of individuals develops coherency. To understand the groups and patterns that constitute social organization, one must ultimately achieve a detailed understanding of the social behavior of individuals. To control the behavior of groups, one must ultimately control the behavior of individuals. Without students, faculty, and administrators, there would be no universities; without workers and managers there would be no corporations; without politicians and civil servants there would be no government; without soldiers and officers there would be no armies.

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Effect of learning to be submissive on status in the peck order of domestic fowl

Stanley C. Ratner

A number of the variables which are related to dominance-submissive relationships among domestic fowl are summarized by Wood-Gush (1955) and Guhl (1953). As they have noted, the variable of past fighting experience has received some experimental attention. Collias (1943), studying predictors of success and failure in encounters between pairs of birds, found that a bird's prior success or failure was one predictor of its subsequent success or failure. More recently Douglis (1948) reported observations of hens which lived part-time in a number of different groups. From these studies she concluded, "The role of conditioning (in terms of learning to dominate or submit) in these experiments is difficult to ascertain." (p. 176). She based this conclusion on the finding that some birds consistently held similar ranks from group to group but others held widely different ranks. A study which was explicitly designed to investigate the role of prior conditioning experience on ranks of domestic fowl, was conducted by Smith and Hale (1959). They found that a bird's rank in a small group could be radically modified as a result of avoidance conditioning experiences in which one bird became the conditioned stimulus for avoidance reactions of others in the group.

While these studies suggest the importance of prior dominating or submitting experiences on peck order relationships, they do not provide a clear answer to the question of the effects of a bird's prior experiences with an opponent on its rank in a peck order which does not involve that opponent. The present study was designed to investigate this question. The study was designed with each experimental bird serving as its own control. That is, the rank of the bird in the peck order was determined and then redetermined after encounters with a despot. This design was adopted in view of the stability of peck orders which is found to occur with mature domestic fowl (Guhl, 1953).

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MATERIALS AND METHODS

Four groups of mature White Leghorn chickens were used. Each group contained 14 birds which were maintained in indoor pens at the poultry laboratory of Michigan State University. The pens which housed each group were 8 × 9 × 14 feet. Each had dirt and sawdust floors and an automatic feeder which extended the length of the pen. Pens were also provided with raised roosts, nesting boxes, water and grit. The pens were situated in a larger building which contained many other such pens.

The encounters between each experimental bird and the despot took place in a wire cage 24 × 24 × 27 inches, which was located in a storage room across a hall from the living pens. A wire cage, similar to the one in which the encounters took place, served as a holding cage for the experimental birds during brief periods between encounters.

The study can be considered to have involved three phases: (*a*) determination of the original peck order, (*b*) encounters between experimental birds and the despot, (*c*) redetermination of the peck order. The three phases were then repeated with the same groups using different experimental birds.

The original peck order was determined in each of the four groups based on notations of fights, pecks, threats, and avoidance responses recorded during twenty 15-minute observations of each pen. A total of 1083 encounters were noted. The data were collected between March 1st and April 15th. Criteria used for defining the responses were the same as those used in a previous study (Ratner and Denburg, 1959). At the conclusion of the twenty observations, the peck order was determined for each pen. The rank of a bird in the peck order was evaluated according to criteria which are described in detail by Allee and Foreman (1955). Linear peck orders were assumed in assigning the ranks of the birds.

Following the determination of the original peck order, one experimental bird was selected from each pen for a series of ten encounters with a despotic hen which had been selected from another group. The experimental birds were selected from intermediate positions in the original peck orders so that either increases or decreases in ranks could occur. The original ranks of the first set of four experimental birds were: 8th, 7th, 5th and 3rd. Each of these birds was placed in the cage with the despot for two 5-minute sessions every day for five days. The despot was in the cage prior to the entry of the experimental bird and food was scattered on the floor of the cage. After placing the experimental bird in the cage, the experimenter noted the behaviours of the two birds during the two 5-minute encounters and removed the experimental bird to the holding cage for a 2-minute rest between the two daily encounters. The order of placing the experimental birds with the despot was varied from day to day.

During the 10-day period when the encounters were taking place, the peck order was redetermined for each pen to evaluate the effects of the encounters on the status of the experimental birds. Ten 15-minute observations were made at each pen for the redetermination of the peck order. The smaller number of observations was used because the original observations provided sufficient data to know the general structure of the order in each pen.

The four groups were allowed to rest for a week to insure the stability of the peck orders and then one more experimental bird was selected from each of the four pens. The ranks of these birds were: 1st, 4th, 3rd and 4th. These birds were selected to provide evidence about the effects of the encounters on higher ranking members of the peck orders. Each of the experimental birds was treated was described for the first set. Each had ten 5-minute encounters with the despot which had previously been used and the peck orders of the four pens were redetermined during the 10-day period when the encounters took place.

Following the main investigation, the despot and several of the experimental birds were given Triflorperazine, a commercial tranquilizer, to determine if the intensity of the encounters would be affected by this activity-reducing drug (Ratner and Ringer, 1959). The drug was administered orally with a pipette. The mixture was prepared with 50 mg. of drug per 1 c.c. of water, and this was given at the dose level of 1 c.c. of mixture per 1,000 g. of body weight. Dose level was based on work by Ringer (in press). Encounters between the treated birds took place 2 to 2½ hours after the mixture was administered.

RESULTS

The main results of the effects of encounters with the despot are summarized in Table 12-1, which shows the original ranks, new ranks, and changes in rank for each of the experimental birds. Data in the fourth column, which shows the change in rank of each experimental bird, indicates that the encounters with the despot led to a reduction in rank in the peck order for

Table 12-1. Original rank, new rank and amount of change in rank in the peck order for each experimental bird.

Bird and pen	Original Rank	New rank	*Change in Rank
R2 (100)	6	8	−2
Y2 (99)	7	9	−2
B2 (98)	5	8	−3
O (96)	3	1	+2
B4 (100)	1	2	−1
R1 (99)	4	7	−3
B—(93)	3	10	−7
R1 (96)	4	6	−2

*Reductions in rank in the peck order are indicated by − and increases by +.

seven of the eight birds. The least reduction occurred for B4 (Pen 100) which moved from the top to the second place in the peck order. The greatest reduction occurred for B— (Pen 98) which moved from third to tenth place. The other experimental birds moved intermediate degrees. It will be noted that one bird, O, (Pen 96), rose in rank to the top position in the peck order from the third position. The changes principally involved a simple shifting in rank for the experimental birds in the pen. It was also observed that six of the seven birds, which were reduced in rank, pecked and threatened fewer birds than they had in the original determination of the peck order, and the seventh bird pecked and threatened the same number.

Analyses of the behaviours during the encounters with the despot showed that the despot strongly dominated each of the experimental birds. That is, with the exception of the relationship between O, (Pen 96) and the despot, all experimental birds received at least ten pecks from the despot per day. During the remaining minutes of the encounter, the experimental birds remained immobile in submissive posture while the despot scratched and ate the food on the floor of the cage.

The two experimental birds, O (Pen 96) and B— (Pen 98), which showed unusual changes in rank in the redeterminations of the peck orders, also had unusual relationships with the despot. Bird O (Pen 96), the bird which rose in the peck order, was the only experimental bird which was not completely submissive to the despot. Although it was pecked and threatened three or four times each session and it never pecked or threatened the despot, it did move about the cage and eat while the despot ate. Bird B— (Pen 98) showed the greatest reduction in rank. This bird received at least 20 pecks per 5-minute session and was judged to be the most severely treated. The treatment of the other experimental birds by the despot could not be quantitatively or qualitatively related to the changes in rank due to the limited variations in treatment and rank which were observed. The behaviour of the despot was quite stereotyped. The pattern of attacks, threats, and eating did not weaken during successive encounters with each bird.

Treatment with the tranquilizer Triflorperazine was undertaken to determine if the drug would alter the behaviour of the despot and/or submissive birds. The results of encounters between the despot and two experimental birds which were drugged, indicated that the aggressive and submissive behaviours were very similar to those observed during regular encounters. The despot pecked and threatened the drugged birds as frequently as it had previously. The visible effect of the drug was to give the birds a "sleepy appearance".

Results of encounters between previously used experimental birds and the drugged despot yielded findings similar to those above. The despot was sluggish in its responses but it pecked and threatened with great frequency and, in addition, quickly dominated two first-ranking birds with which it had had no prior experience.

DISCUSSION

The results of encounters between experimental birds and a despot in a situation different from the home pen indicated that the experiences affected status in the peck order. Specifically, the encounters were associated with a reduction in rank in the peck order for seven of the eight birds and an increase in rank for one of the birds.

These findings can be interpreted in terms of the concept of conditioning of submissive reactions to the despot which generalized to the birds in the home pens. That is, the encounters can be considered as conditioning trials in which the movements of the despot (conditioned stimuli) were repeatedly associated with vigorous pecks (unconditioned stimuli) which led to submissive and avoiding responses (unconditioned responses), on the part of experimental birds. The finding that the experimental birds spent much of the time during encounters in submissive postures and avoiding the despot even when not being pecked supports this interpretation. The study by Smith and Hale (1959) reports that as few as ten presentations of electric shock (unconditioned stimulus) were required to condition a chicken to avoid another for two to nine weeks. The present study, while not using shock, involved many presentations of the unconditioned stimulus of pecking for each experimental bird. Generalization of a conditioned response to stimuli similar to the original conditioned stimulus is commonly found. Thus, the reductions in rank and in the peck orders involving the experimental birds are interpreted in terms of generalization of submissive reactions to birds in the home pens which approached or threatened the experimental birds.

This interpretation suggests that the experimental birds should have dropped to the bottom of their respective peck orders, which did not occur. That is, they continued to peck and dominate some birds in their pens. However, these birds had had long histories in their pens and there is no reason to think that conditioning of submissive and avoidance responses should obliterate previously learned aggressive responses. Also the very low ranking birds which did not "know what the experimenters had done to the experimental birds" continued to make their previously conditioned avoidance responses to the experimental birds. The birds which were instrumental in reducing the status of the experimental birds were principally those close to them in rank.

The extreme change in rank shown by the bird B—, which dropped seven places in the peck order, can be interpreted as a result of the extreme degree of conditioning of submissive and avoidance responses which occurred for it. The increase in rank shown by one bird (O) cannot be readily interpreted with the present concepts. The bird was dominated by the despot but was not pecked and beaten as the others were. One interpretation of the added

vigour of the bird's responses in the home pen is in terms of the occurrence of conflict between fighting and submitting during the encounters which was resolved in the home pen into increased fighting.

The results of moderate doses of tranquilizer on the behaviour of the despot and other birds indicated that the drug did not alter the direction nor the degree of encounters between the pairs of birds.

SUMMARY

The present study was designed to investigate the effects on rank in the peck order of encounters between experimental birds, which were taken from intact peck orders, and a despotic bird not involved in the peck orders. Four groups with 14 birds in a group were observed to determine the peck orders. A total of eight experimental birds was selected from these groups and each had a number of encounters with a despotic bird which was not a member of any of the groups. The peck orders were then redetermined to evaluate the effects of the encounters on the ranks of the experimental birds. Seven of the eight birds showed reductions in rank after the encounters, and the eighth showed an increase. The characteristics of the encounters were related to the changes in ranks of several of the experimental birds. Tranquilizers were found to have little effect on the behavior of the despot or the experimental birds. The effects of the encounters are interpreted in terms of conditioning of submissive and avoidance responses which generalized to the home pens.

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The modification of social dominance in a group of monkeys by interanimal conditioning

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The conditioned response paradigm has been of some theoretical interest to social psychologists for many years. A number of writers have employed conditioning terminology in speculating upon the development and elaboration of social and emotional responses (7, 10, 11). Others deny the applicability of conditioning principles to social phenomena, at least until sound experimental evidence has been reported (1, 2, 6). The discussions pro and con, about the usefulness of conditioning as a model in this area are somewhat ethereal in that only limited data from experimental social situations are available upon which predictions can be based. Lambert has recently reviewed the theoretical and experimental extensions of S-R theory to social psychology (5).

A previous report (12) described the procedures employed in interanimal avoidance conditioning and provided information concerning the rate

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of conditioning and extinction. In addition, the amount of generalization of the conditioned avoidance response to monkeys other than the conditioned stimulus was determined as well as the results of the specific discrimination training trials. Briefly, it was found that an avoidance response could readily be established in the monkey using another monkey as the conditioned stimulus; that such an avoidance response did generalize to some extent to other monkeys; and that with specific discrimination training the stimulus animal could be discriminated from other monkeys at a high level.

From the fear-reduction interpretation of avoidance conditioning the conditioned stimulus animal should acquire the property of eliciting fear in the conditioned animal as a result of the repeated association with a noxious stimulus (10). The present experiment was designed to determine whether fear developed by interanimal avoidance conditioning would transfer to another situation and modify the social interactions between the conditioned animal and the stimulus animal.

METHOD

Subjects

A group of eight male and two female adolescent rhesus monkeys were the *Ss* in this experiment. The social dominance hierarchy and the nature of social interactions of this group had been studied for a period of approximately 20 months prior to the beginning of this experiment. Previous reports on these animals have detailed the stability of dominance behaviors (8) and the effects of social interactions upon discrimination learning (9).

Apparatus

The apparatus used to establish the avoidance response has been described in detail in a previous report (12). Briefly, it consisted of a large rectangular box divided into two compartments separated by a one-way-vision screen. The floor of each compartment was an electrifiable grid. Electronic control devices enabled *E* to alter the illumination differentials in such a manner as to allow the conditioned *S* to see clearly through the one-way screen into the adjoining compartment where the monkey serving as a conditioned stimulus was present. A delay device presented an electric shock to the conditioning *S* following a 5-sec. exposure of the stimulus animal. The pulling of a bar mounted in the conditioning compartment enabled the animal to escape the shock or to avoid it if the response occurred within the 5-sec. interval. The instrumental response also removed the stimulus monkey from view, i.e., response-terminated stimuli were employed.

Dominance tests were conducted in the Wisconsin General Test Apparatus (WGTA) described by Harlow and Bromer (4).

Procedure

The social dominance hierarchy within the group of ten monkeys had been determined on six separate occasions during the 20 months preceding the present experiment. The dominance relationships had been found to be stable over this period of time (8).

The animal chosen to serve as a conditioned stimulus for pain avoidance for other members of the group was no. 53. His mean dominance rank for the six pretests was eighth in the group (Table 12-3), and during these same tests he had dominated only one animal (no. 60) consistently and tied with another (no. 59). This monkey was selected because he was low in dominance status, and changes incurred by the independent variable in the direction of an increase in his dominance could, therefore, be of relatively large magnitude. The relationships within this group have been fully described in the previous report (8).

During conditioning no. 53 was placed in the stimulus compartment of the apparatus. The *S* to be conditioned was placed in the adjoining compartment, which contained the response bar. On a conditioning trial, *E* switched the lighting arrangement so that the stimulus animal was clearly visible from the conditioning compartment. After a 5-sec. exposure of the stimulus animal, a 30-v. electric shock was automatically placed on the grid of the conditioning compartment. The bar-pulling response was facilitated during the initial 30 trials by means of the method of successive approximations (14).

The trials were presented at a rate of 30 trials per day with an average of 60 sec. between trials. To eliminate the possibility that *S* might become conditioned to some cue accompanying the change in lighting arrangement rather than to the stimulus animal, 50 per cent of the trials were control trials. On a control trial the stimulus monkey was removed from the stimulus compartment. The lighting differential was then switched, presenting the conditioning *S* with a view of the empty compartment. This exposure of the empty compartment was terminated by *E* after 5 sec. and, of course, was never accompanied by shock to the conditioning *S*. During the initial five days the control trials were regularly alternated with conditioning trials. Gellermann series were utilized thereafter to intersperse conditioning and control trials (3).

Since it was desired to test the dominance relationships in a systematic fashion throughout the experiment, conditioning trials were arbitrarily run for eight-day periods, then dominance was determined for the entire group of animals on the ensuing five days. This alternating sequence was followed for a period of 14 weeks (seven conditionings and seven dominance tests).

The individual animals which were conditioned to avoid no. 53, and the temporal order of their conditioning is detailed in Table 12-2.

One additional conditioning was attempted during the experi-

Table 12-2. Animals conditioned to avoid the stimulus monkey in successive conditioning periods

Conditioning Periods	Animals					
1					57	
2					57	52
3						52
4					57	
5					57	
6	54	55	58	59	60	61
7	54	55	58	59	69	61

ment. Animals no. 54 and no. 56 had been competitive with each other for second position in the dominance hierarchy for many months. This dominance relationship was known to be flexible and, therefore, would be sensitive to the effect of such an independent variable as interindividual conditioning. As indicated in Table 12-4, no. 56 had gained ascendancy over no. 54. Consequently, no. 54 was made the stimulus animal for avoidance by no. 56 during conditioning periods 3, 4 and 5 in an attempt to determine whether no. 54 would assume dominance over no. 56 in the social interaction situation.

The specific procedures employed in determining the dominance hierarchy within the group of ten animals was fully described in a previous paper (8). Essentially, each animal was tested for dominance against each other animal in the group in a standardized food-getting situation.

RESULTS

The dominance data for the six tests preceding interanimal conditioning and for the seven tests which occurred between successive conditionings are shown in Table 12-3. Each entry is the dominance rank achieved by an animal on a particular dominance test. The most dominant rank was 1, and the most submissive was 10. The animals were ranked on any given test according to the number of competitors dominated on that test. For example, the monkey which secured the majority of pieces of food from the greatest number of other animals in the group was ranked first in dominance. In the event that animals were tied in number of animals dominated during a test, that monkey securing the larger total number of pieces of food was accorded the higher rank.

In order to assess the significance of changes in dominance status subsequent to conditioning, the mean and standard deviation were computed for each individual over the six tests preceding the introduction of conditioning. These data are reported in Table 12-3. Fiducial limits were obtained by taking $M \pm 3\,\sigma$. The variability of individuals in dominance was found to differ markedly. The ranks achieved on each of the seven dominance determinations during conditioning were evaluated for each individual with the

Table 12-3. The dominance ranks of ten monkeys on six pretests and seven tests taken following interindividual avoidance conditionings

Animal	Dominance prior to conditioning						M	σ	Dominance tests during avoidance conditioning						
	Test								Test						
	1	2	3	4	5	6			1	2	3	4	5	6	7
52	4	4	6	4	5	6	4.83	.92	5	4	6	6	6	5	6
53(CS)	7	9	7	7	8	9	7.83	.92	6	6	4*	4*	3*	3*	4*
54	3	2	2	1	4	3	2.50	.96	3	3	3	3	1	2	2
55	1	1	1	2	2	2	1.5	.50	2	1	1	1	2	6*	1
56	5.5	3	3	3	1	1	2.75	1.52	1	2	2	2	4	1	3
57	2	6	4	5	3	4	4.0	1.30	4	5	5	5	5	4	5
58	9	6	9	6	7	7	7.33	1.29	7	9	10	9	8	9	9
59	8	10	10	9	9	10	9.33	.79	8	7	8	10	9	10	10
60	10	8	8	8	10	8	8.67	.91	10	8	7	7	7	7	7
61	5.5	6	5	10	6	5	6.25	1.73	9	10	9	8	10	8	8

*Rank falls outside fiducial limits of $M \pm 3\sigma$ established from base line of six pretests.

fiducial limits obtained from the premeasures. As indicated in Table 12-3, the only significant changes in dominance occurred in the increase in status for no. 53 following conditioning periods 3, 4, 5, 6, and 7, and a drop in dominance for no. 55 following period 6.

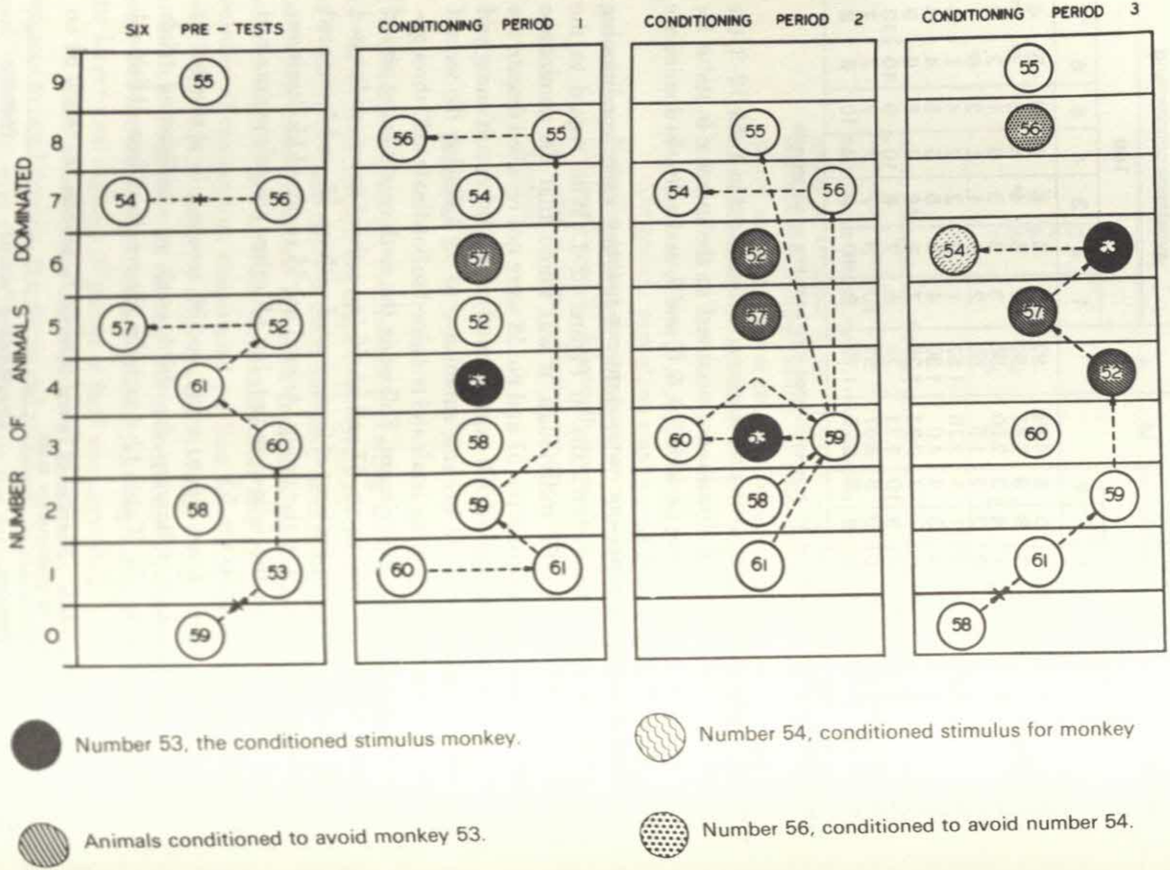
The detailed dominance relationship following each conditioning period are presented sociometrically in Figure 12-1. With regard to the results obtained for specific individuals, it was found that the dominance relationships between animals no. 57 and no. 53 were not reversed despite the fact that 57 was given a total of 960 experimental trials (480 conditioning and 480 control). Animal no. 52 became submissive to 53 following the second week of avoidance conditioning trials and remained subordinate to 53 throughout the remainder of the experiment. Following the sixth conditioning period no. 53 was submissive only to no. 57 and no. 56 (an animal never conditioned to avoid no. 53), he tied in amount of food secured with no. 55, and dominated the remaining six animals in the group. Animal no. 55 regained his dominant position over no. 53 on the following test, but all other animals maintained their status with respect to no. 53.

The conditioning of no. 56 to avoid no. 54 resulted in a reversal in dominance relationships following the third week of conditioning trials (conditioning period no. 5). Table 12-4 includes the results of four additional

Table 12-4. Number of raisins obtained by animals no. 54 and 56 on successive dominance tests

Animal	Pretests						Conditioning Periods							Posttests			
	1	2	B	4	5	6	1	2	3*	4*	5*	6	7	1	2	3	4
54	3	10	7	10	0	0	0	0	2	4	8	8	10	1	0	0	0
56	7	0	3	0	10	10	10	10	8	6	2	2	0	9	10	10	10

*Animal no. 56 conditioned to avoid no. 54 in the preceding eight days.


SIX PRE - TESTS
CONDITIONING PERIOD 1
CONDITIONING PERIOD 2
CONDITIONING PERIOD 3
NUMBER OF ANIMALS DOMINATED
0
1
2
3
4
5
6
7
8
9
55
56
54
57
52
61
60
58
53
59
Number 53, the conditioned stimulus monkey.
Animals conditioned to avoid monkey 53.
Number 54, conditioned stimulus for monkey
Number 56, conditioned to avoid number 54.

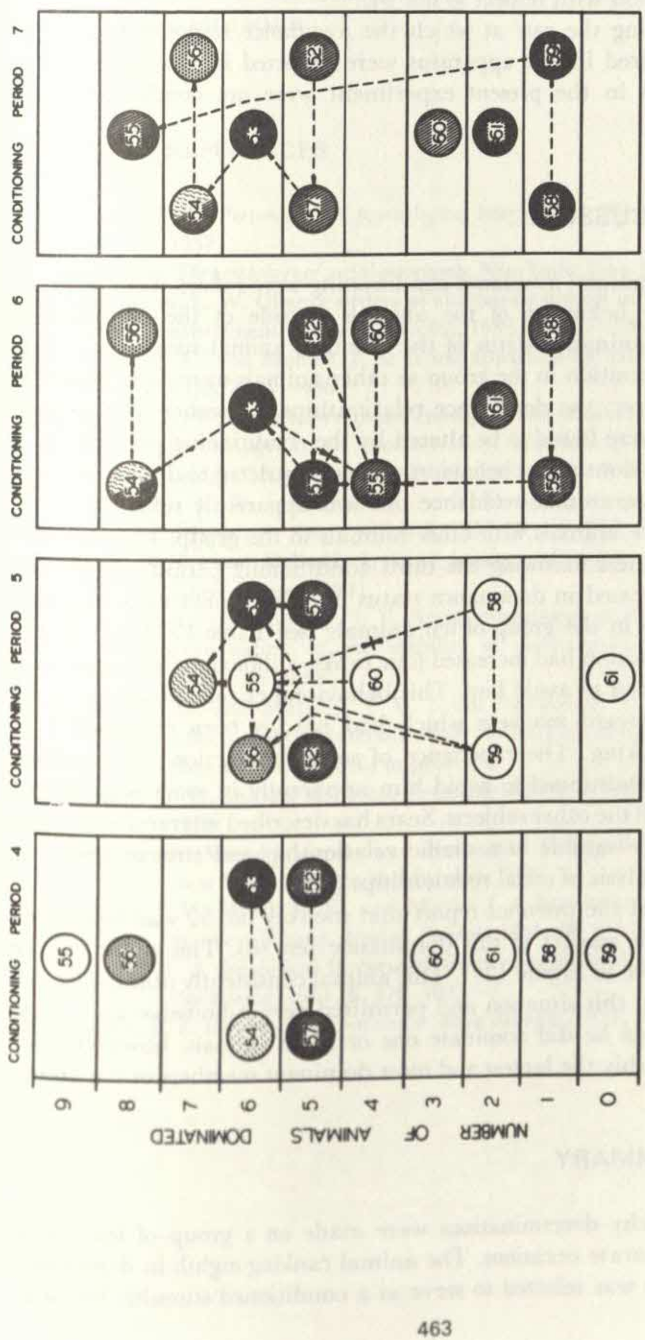


Figure 12.1. Sociograms of the dominance relationships within the group of ten monkeys prior to and following successive conditioning periods. Dotted arrows indicate discrepancies in the dominance hierarchy, i.e. animals lower in the hierarchy which dominate animals higher in the group. Ties are shown by joined arrows.

post tests which occurred during the five months following the last conditioning period. It can be seen that during these posttests no. 56 regained his dominant position with respect to no. 54.

Data concerning the rate at which the avoidance response to another individual is acquired in this apparatus were reported in a previous paper (12). The subjects in the present experiment were not conditioned to a criterion.

DISCUSSION

The effects of interanimal avoidance conditioning were reflected significantly in the dominance behaviors of the animals outside of the conditioning apparatus. The dominance status of the stimulus animal rose significantly from his previous position in the group as other animals were conditioned to avoid him. Moreover, the dominance relationships of another pair of competitive monkeys were found to be altered by the conditioning procedures.

The change in dominance behaviors was not restricted to the specific pair participating in interanimal avoidance but was apparently reflected in the relationship of these animals with other animals in the group. For example, on the dominance test following the third conditioning period, no. 53 was found to have increased in dominance status from his former rank of eighth to a rank of fourth in the group of ten animals (see Table 12-3 and Figure 12-1). Thus, his position had increased four ranks, although only two animals had been conditioned to avoid him. This behavioral change observed in the stimulus animal toward monkeys which had not yet been conditioned to avoid him was striking. The experience of social interaction with animals which had been conditioned to avoid him apparently in some way altered his behavior toward the other subjects. Sears has described interactive changes such as this as attributable to a diadic relationship and stresses their importance in the analysis of social relationships (13).

It was noted in the previous report that monkey no. 59 was considered to be atypical with respect to this dominance test (8). This point can be clarified by reference to Figure 12-1. This animal consistently obtained a low dominance score in this situation and permitted very submissive animals to take the food. When he did dominate one or more animals, however, they were almost invariably the largest and most dominant members of the group.

SUMMARY

Dominance hierarchy determinations were made on a group of ten rhesus monkeys on six separate occasions. The animal ranking eighth in dominance status in the group was selected to serve as a conditioned stimulus for pain-

avoidance by other members of the group. After each conditioning of another animal to avoid the stimulus monkey the dominance hierarchy within the group was retested. It was found that the stimulus monkey increased significantly in dominance status.

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Reinforcement of leadership behavior in group discussion

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Oakes, Droge, and August (1960) developed a procedure for reinforcing individual behavior in a group discussion situation. Essentially, this procedure involves the presentation of signal light flashes to individual subjects by means of a hooded panel, such that the light flash is visible only to the individual subject. The reinforcing character of the light flash is established through instructions given to the subjects. Oakes *et al.* demonstrated that the presentation of light flashes established as positive or negative reinforcers through instructions increased or decreased, respectively, the participation of the subjects in group discussion.

In subsequent studies using this procedure, Oakes *et al.* (1961) showed that conclusions reached by individual subjects in group discussions could be influenced by this reinforcement procedure; that not all response classes were equally conditionable (Oakes, 1962a); and that the prestige value of the presumed source of the signals influenced the reinforcing effect of the signals (Oakes, 1962b).

Using essentially the procedure developed by Oakes *et al.*, Hastorf (1965) showed that the perceived leadership status of one of the participants in such a group discussion could be influenced through reinforcement of his participation in the discussion. In the Hastorf study subjects discussed one case history without reinforcement, then ranked the group members on a sociometric questionnaire. The third-ranked subject in the group of four, on the basis of that questionnaire, was then taken as the target person (TP). The group then discussed a second case, with the TP receiving a positive light flash for verbalization and a negative light for nonparticipation (Hastorf had a green positive and a red negative light in each individual subject's hooded panel). The three non-target persons (NTPs) got positive lights whenever they made statements agreeing with TP and negative lights when they verbalized otherwise. The sociometric questionnaire was again used at the end of the second discussion, in which the reinforcements were presented. This was followed by a third discussion in which no lights were used, at the end of which the sociometric questionnaire was presented a third time.

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Hastorf's results indicated that the sociometric status of TP as perceived by NTPs increased significantly after the reinforcement session, with only a slight decline after the extinction session. The same was true of the proportion of verbalization attributable to TP. The findings of the Hastorf study have important implications for the study of leadership and suggest many questions for further research.

Methodological questions are raised, however, regarding the possible reactive nature of the sociometric questionnaire and a possible confounding due to the wording of the questionnaire itself. The four questions on which subjects were to be rated were as follows: Who would you say was the group's leader? Who would you say talked the most? Who would you say had the best ideas? Who would you say did the most to guide group discussion?

It is conceivable that such a questionnaire might focus the attention of the subjects on such matters, or provide demand characteristics (Orne, 1962), which could produce or enhance the effect obtained. Furthermore, what is referred to as sociometric status by Hastorf is confounded by the second question on the survey, which deals with "who talked the most." Actually it is only the remaining three questions that deal with status.

It is conceivable that the effect of the signal light reinforcement was to increase TP's verbalization, and that this did not enhance TP's leadership status as perceived by the NTPs in the group. Since the rank of TP on the question, "Who would you say talked the most," was included by Hastorf in an amalgam index of "sociometric status," the enhanced sociometric status reported could be simply the result of TP talking more. Thus in the present study the questions covering leadership status are analyzed separately from the one concerned with amount of talking.

In order to assess the possible reactive nature of the questionnaire, in the present study the prequestionnaire, i.e., the one given after the initial discussion but before the reinforcement session, was used in only half the groups. Thus comparisons can be made of subjects possibly sensitized by the questionnaire and those not.

Hastorf reported a very high correlation between amount of subjects' verbalization and the sociometric ranking. In half the groups of the present study no initial sociometric questionnaire was used; in these groups TP was chosen on the basis of amount of participation. In the other half the questionnaire was used. Otherwise the procedure for the groups was the same. Another independent variable manipulated was the use of lights, i.e., the presentation of reinforcements. Thus four sets of groups were used, two sets receiving light reinforcement and two sets not receiving light reinforcement. And, in an orthogonal design, two sets received the initial questionnaire and two sets did not receive the questionnaire.

METHOD

Subjects

Fifty-six four-person groups were used. The 224 subjects were volunteers from introductory psychology classes at the University of Hawaii. They were assigned at random to one of four conditions: survey, lights (SL); no survey, lights (NSL); survey, no lights (SNL); and no survey, no lights (NSNL).

Procedure

The experimental procedure used was essentially that of Hastorf (1965). For all groups the experiment was divided into three parts or sessions. The first or operant session was a ten-minute discussion of a human relations problem. At the end of the operant session a sociometric questionnaire was administered to groups in the Survey condition. The questionnaire consisted of the following items, on which all participants were to be ranked: (a) Who would you say was the group's leader? (b) Who would you say talked the most? (c) Who would you say had the best ideas? and (d) Who would you say did the most to guide group discussion? This questionnaire was omitted following the operant discussion for the No Survey condition.

The TP was chosen by selecting the person ranked third on the questionnaire, or the person ranked third in speaking time in the No Survey condition.

A twenty-minute discussion on a second human relations problem followed. This was called the reinforcement session. In the reinforcement session for all groups in the Lights conditions, TP received positive (green) light flashes, indicating reward, for verbalization, and negative (red) light flashes, indicating punishment, for silence. NTPs received negative lights for excessive verbalization or for expressing opinions, and positive lights for agreeing with TP. The questionnaire was administered to all groups at the conclusion of the reinforcement session.

A third ten-minute discussion, called the extinction session, on a third human relations problem followed. No lights were expected or delivered during the extinction session. Its purpose was to determine whether the effect of the previous reinforcement persisted into this period. All groups received the questionnaire at the conclusion of this session.

For each group the experiment began with subjects being escorted from a common Subjects' Waiting Room to the experimental room by the second author, and being seated in alphabetical order around the table. Each subject had a panel containing a red and a green light, visible only to him, before him on the table. The room was equipped with a one-way-vision glass between the experimenters' room and the subjects' room, an intercom system, and a microphone connected to one channel of a stereo tape recorder in the

adjacent experimenters' room. The subjects were read the following instructions:

> "I am Dr. Oakes, your experimenter. This is a study to assess the ability of psychology students to solve human relations problems. This is a completely programmed experiment in which you will use, in sequence, the folders before you. Additional instructions will come to you by way of the intercom. You will find your first sheet of instructions in folder A. Please follow these instructions carefully. Do not go on to additional sheets or folders until you are told to do so. These instructions are self-explanatory. I can answer no questions about them. If you do have any questions, please read the instructions again. At certain times during the experiment my graduate assistant will come into the room to pick up questionnaires that you have completed. Please fill out these questionnaires quickly and promptly. You may now open folder A. Read the instructions only. I'll be in the control room where I can monitor your discussion."

Before each subject was a stack of three folders marked A, B, and C. In order, within folder A were instructions (A), the human relations problem to be discussed, and the sociometric questionnaire if it was under the Survey condition. In folder B were instructions (B) for the Lights condition, the second problem, and the questionnaire. In folder C were instructions (C), a third human relations problem, and the final questionnaire.

Instructions (A) read as follows:

> "Please read these instructions carefully and be sure that you understand them. Beneath this sheet is a human relations problem taken from the files of our Social Psychology Laboratory. You are asked to discuss this problem in terms of the complications which might arise and the solutions which might be attempted. Also discuss the individual or group dynamics that might be involved.
>
> "I am Dr. Oakes, a professional psychologist. I, along with a panel of human relations experts, will be monitoring the discussion from another room. In this experiment it is necessary that you identify yourself each time you speak. Use no names for this identification. Instead, identify yourself by the letter of your position (located in front of you) each time you speak. Do it this way: Say 'I'm W . . . ,' or 'West, I think . . . ,' etc. Please do not discuss anything else except that which pertains to the human relations problem itself.
>
> "When I flash both of your lights, begin to read the human relations problem in this folder. When I flash your lights a second time begin the discussion. The discussion will last ten minutes."

Instructions (B) were used only in the Lights condition. In the No Lights condition verbal instructions were given by way of the intercom. Instructions (B) read as follows:

> "In this folder is a second human relations problem. Dr. Oakes and the human relations panel will again monitor your discussion, but this time they will let you know how you're doing. Whenever you make a contribution to the discussion which is helpful or functional in facilitating the group process your green light will go on. Whenever you behave in a way which will eventually hamper or hinder the group process your red light will go on. Do not mention the fact that you have received a green or red light or no light at all. Furthermore, do not make any attempt to observe the lights of any of the other participants. Again identify yourself by position before you speak. Begin reading the human relations problem in this folder when both your lights flash. When they flash a second time begin the discussion. You will have twenty minutes for this discussion."

Instructions (C) read as follows:

> "In this folder is a final human relations problem. This is not a feedback session. However, the panel will monitor your discussion. Remember to identify yourself before you speak. When both lights flash begin reading the human relations problem in this folder. When they flash a second time begin the discussion. This discussion will last ten minutes."

The first author entered the experimental room to collect questionnaires as they were completed. Other contact with the subjects was by way of the intercom. At appropriate times subjects were told when the discussion had been completed, when to complete questionnaires, when to close folders, and when to go to the next folder.

For subjects in the No Lights condition, in place of the written instructions (B), subjects were told to read the next problem in anticipation of a discussion that would last twenty minutes. Flashing of both lights signaled the beginning of the discussion.

At the conclusion of the experiment the subjects were asked not to discuss the experiment either among themselves or with others, and were told that the results would be made available to them at a later date.

In the control room the experimenter controlled the intercom, the lights for each subject, clocks that recorded the length of speaking time for each subject, and a stereo tape recorder. Whenever reinforcements were presented, the experimenter noted this by speaking into his microphone and recording this on the second channel of the stereo tape recorder. Thereby a permanent record of the position, type, and time of reinforcement was obtained.

RESULTS

The data obtained during the experiment included the sociometric ratings of the TP made by the NTPs, the total speaking time of each subject for each of

Table 12-5. Summary of analysis of variance of TP mean sociometric rankings on the sum of the four sociometric questions

Source	*df*	*MS*	*F*
A (Lights)	1	8.14	8.66**
B (Survey)	1	0.03	—
AB	1	0.75	—
Error between	52	0.94	
C (Session)	1	0.17	1.13
AC	1	0.47	3.13*
BC	1	0.16	1.07
ABC	1	0.03	—
Error within	52	0.15	

*$p < .10$. **$p < .01$.

the sessions, and a tape recording of the entire discussion. Analyses of variance were made using the mean of the ratings for each TP by the three NTPs in his group at the end of the reinforcement and extinction sessions under the various conditions. The first analysis used the ratings on all four questions, while the second involved only the three items that were concerned with leadership status. In both cases this resulted in a three-factor mixed model analysis of variance, the between-subjects treatments being reinforcement (A) (L versus NL), and survey (B) (S versus NS). The within-subjects treatment was session (C) (reinforcement session versus extinction session). Table 12-5 presents the results of the analysis using all four questions as Hastorf (1965) did.

It can be seen from Table 12-5 that there was a significant main effect of Lights ($F = 8.66$, 1 and 52 *df*, $p < .01$), and the suggestion of an interaction between Lights and Session ($F = 3.13$, 1 and 32 *df*, $p < .10$). This situation was further clarified when this same analysis was made using the questions dealing only with status. Table 12-6 presents the summary of that analysis.

The analysis of the results on the status questions again showed a significant effect of Lights ($F = 7.13$, 1 and 52 *df*, $p < .01$); however, in this analysis the Lights by Session interaction was clearly significant ($F = 4.38$, 1 and 52 *df*, $p < .05$). A comparison of TP mean ratings shows that ratings for

Table 12-6. Summary of analysis of variance of TP mean sociometric rankings on the three questions indicating status

Source	*df*	*MS*	*F*
A (Lights)	1	6.77	7.13**
B (Survey)	1	0.02	—
AB	1	0.88	0.93
Error between	52	0.95	
C (Session)	1	0.32	2.00
BC	1	0.17	1.06
AC	1	0.70	4.38*
ABC	1	0.17	1.06
Error within	52	0.16	

*$p < .05$. **$p < .01$.

Table 12-7. Summary of analysis of variance of percentage of speaking time for target persons

Source	*df*	*MS*	*F*
A (Lights)	1	1511.16	7.97**
B (Survey)	1	230.87	1.22
AB	1	58.29	—
Error between	52	189.53	
C (Session)	1	121.39	2.56
AC	1	113.21	2.38
BC	1	206.28	4.34*
ABC	1	31.29	—
Error within	52	47.51	

*$p < .05$ **$p < .01$.

the Lights groups were significantly higher than those for the No Lights groups at the conclusion of the reinforcement session ($t = 3.19$, 54 *df*, $p < .01$), and that this difference, although considerably reduced, was still significant at the conclusion of the extinction session ($t = 2.06$, 54 *df*, $p < .05$).

The percentage of talking time of TP was chosen as the most convenient and economical participation measure, after a preliminary analysis had shown a very high correlation between it and the total number of words spoken by each subject, which would be a more precise measure of participation. Correlation between these two measures in each of the three sessions for members of six groups chosen at random were .96, .95, and .91 for the operant, reinforcement, and extinction sessions, respectively.

Table 12-7 presents the summary of an analysis of variance of the percentage of talking time, which again is a three-factor mixed model design. It can be seen that the effect of the Lights was significant ($F = 7.97$, 1 and 52 *df*, $p < .01$). Moreover, the interaction between Survey and Session was also significant ($F = 4.34$, 1 and 52 *df*, $p < .05$).[1]

Inspection of the cell values for the significant Survey by Session interaction shows that in the reinforcement session TP's proportion of talking time was the same whether or not his group had the initial survey (although, of course, the reinforced TP talked more than the nonreinforced TP). In the extinction session, however, TP's proportion of talking time in groups without the initial survey was considerably less than it had been in the reinforcement session (although again, of course, the reinforced TP talked considerably more than the nonreinforced TP). Although the triple interaction was not significant, inspection of those cell values suggests that the decrease in TP's proportion of talking time from reinforcement to extinction session for groups *without* the initial survey was *less* for the nonreinforced than for the reinforced TP, while the increase in TP's proportion of talking time from reinforcement to extinction session for groups *with* the initial survey is *greater* for the nonreinforced than for the reinforced TP.

[1] An analysis of covariance, in which the operant session value was used as a covariate, was also made, but except for increasing the value of F for reinforcement ($F = 15.71$, 1 and 51 *df*, $p < .001$), the results were essentially the same as with the analysis of variance.

Table 12-8. Mean percentage of speaking time for target persons

Group	Operant	Session	
		Reinforcement	Extinction
SL	13.8	26.2	25.9
NSL	13.2	25.6	17.8
SNL	17.2	16.4	18.0
NSNL	13.2	16.7	14.9
Σ Survey	31.0	42.6	43.9
Σ No survey	26.4	42.3	32.7
Σ Lights	27.0	51.8	43.7
Σ No lights	30.4	33.1	32.9

Table 12-8 presents the mean percentage of talking time for TPs under the various conditions and sessions.

DISCUSSION

The results of all analyses show a significant effect of reinforcement lights on both talking time and the sociometric status of TPs. Sociometric status was not appreciably changed when the effect of the alien question on the survey was removed. However, when the results from this question were left out of the analysis, a clear interaction between Lights and Session was noted. A comparison of group mean ratings revealed that a powerful reinforcement effect due to the lights was obtained at the end of the reinforcement session, and that this effect was considerably lessened at the end of the subsequent extinction session. Although in this latter case the difference between the group means is decreased, the reinforcement effect is still significant.

The significant effect of reinforcement is again evident when the percentage of talking time is taken as the dependent variable. In this case, however, the results provide support for the notion that the initial questionnaire is somewhat reactive. It does not seem that the initial questionnaire is reactive in the simple sense in which we had initially anticipated it might be, i.e., that the reinforcement effect was dependent on sensitization by an initial questionnaire. This sort of sensitization would have produced a significant reinforcement by survey interaction, or, possibly, a significant triple interaction of reinforcement, survey, and session. What was found instead was an effect of the inital survey on both the reinforced and nonreinforced TPs. Further, it seems to be somewhat of a sleeper effect, such that the survey and no-survey TPs talk about the same amount during the reinforcement session, but only the no-survey TPs show a decrease in percentage of talking time in the extinction session. Thus the effect of the initial survey is to keep TP's proportion of talking time from dropping off in the extinction session, but this is true for both the reinforced and nonreinforced TPs. This sort of reactivity of the survey is somewhat more difficult to understand than

the simple interaction of survey with reinforcement that we had originally anticipated as a possibility.

Looking at the differences in the situation for the survey and no-survey groups at the time of the extinction session, we see that whereas the survey groups had been led (by the initial questionnaire) to believe that the experiment was concerned with leadership before the second (reinforcement) session, the no-survey group had probably not realized this until their first questionnaire was presented, after the reinforcement session and immediately before the extinction session. Subjects in these no-survey groups thus realized, after having discussed two cases, that the experimenter was concerned with who the group leader was, who talked the most, etc. It is conceivable that such realization could provide increased incentive, especially for the more ascendant subjects in the group, i.e., those ranked first and second in talking time on the initial session, to participate more in the discussion. This would have the effect of producing during the final session a decrease in proportion of talking time for TP, who was initially third-ranked in talking time. If this is what did produce the effect, we would expect to find an increase in proportion of talking time for the initially first-ranked subjects in the no-survey groups from reinforcement to extinction session, and we would also expect to find a decrease in proportion of talking time of TP in the survey group without reinforcement from operant session to reinforcement session. We would expect this decrease in TP's proportion of talking time in group SNL from operant to reinforcement session because this is the point at which the initial questionnaire would lead that group to realize that the experimenter was concerned with leadership. It can be seen from Table 12-8 that the expected decrease did occur for group SNL. (We would not expect a comparable decrease for group SL, since the reinforcing lights were working in opposition to such an effect for that group during the reinforcement session.)

The proportion of talking time attributable to the initially first-ranked subjects in the no-survey groups in the reinforcement and extinction sessions is shown in Table 12-9.

It can be seen from Table 12-9 that the expected increase in proportion of talking time did occur from the reinforcement to extinction sessions for these no-survey groups.

The above suggested interpretation of the significant survey by session interaction remains, of course, only a suggestion, as the *post hoc* data analysis

Table 12-9. Mean proportion of talking time of subjects initially ranked first in no-survey groups

Group	Session	
	Reinforcement	Extinction
NSNL	42.98	48.15
NSL	35.60	44.07

cannot establish its validity. It does seem a reasonable interpretation of the results, however.

Thus the findings of the present investigation may be summarized as follows:

(1) The reinforcement lights exerted a significant effect on TP's proportion of talking time and his leadership status as perceived by other group members, whether or not an initial questionnaire was used.
(2) The reinforcement effect on TP's talking time and leadership status was greater during the reinforcement session than during the extinction session, but a significant effect remained in the extinction session.
(3) Presence or absence of the initial questionnaire exerted no significant main or interactive effect on TP's leadership status.
(4) The only significant effect of presence or absence of the initial questionnaire on TP's proportion of talking time was the survey by session interaction, with TP talking proportionately less in the extinction than in the reinforcement session for both reinforced and nonreinforced groups.
(5) A suggested interpretation of this effect of the survey was made, involving heightened motivation for participation by ascendent subjects in the no-survey groups in the extinction session, resulting from their just having had the questionnaire for the first time, which would at that time emphasize for them that the experimenter was interested in leadership.

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13

CULTURAL CONTROL OF SOCIAL BEHAVIOR

The control of the behavior of individuals by the social group in which they live is as old as the human practice of living in groups. In small, extremely primitive groups, control probably occurred primarily in direct social relations between individuals. As seen in the preceding chapter, reinforcement and punishment of and between individuals will generalize to control the individual's behavior in a small group. As groups become less primitive, social control may occur in the form of codes of behavior that are consistently, though informally, applied. Finally, as societies become larger and more complex, formal legal systems are developed specifying the rules of behavior and the consequences of deviation from the rules. In legal systems, from the most ancient to the most modern, rules are most often in the form of "Thou shalt not. . . ." Formal, legal control of behavior almost always depends on punishment of deviations from the behavioral rules. Indeed, our "modern" legal system may be regarded as a cultural living fossil. Man's preception of his universe, of himself, and of his place in nature have been radically changed. Our culture no longer believes that the world rides on a turtle's back or emerges periodically from Vishnu's navel. Yet our culture's formal system for controlling the behavior of individuals has been inherited, with only minor changes, from times when the most primitive concepts of man and his universe were in force.

Of course, not all cultural control of behavior is in the form of legal admonitions enforced by aversive stimuli. The development of much social behavior, such as verbal behavior, is reinforced by positive social stimuli. Work is reinforced by money. Motherhood is reinforced, not only by stimuli emitted by the child, but also by happy grandmothers. Aversive stimuli also informally control behavior. Nearly all the behavior controlled by positive reinforcers, however, seems to fall outside the formal legal system. The worker feels that his behavior is controlled, not by the culture, but by his desire to work or his need for money. The mother feels her behavior is controlled by the joys of

motherhood. Such perceptions characterize informal control as "natural." On the other hand, to many people, the deliberate, cultural control of behavior is synonymous with the type of formal, aversive control exercised by the legal system.

The traditional methods of cultural control of behavior have evolved by trial and error (Skinner, 1961). The methods do manage to control behavior, but the control is haphazard and often malfunctions. Until recently, no real understanding has been achieved of the factors that control human behavior. No basis existed for the intelligent design of cultural practices. However, in the past few decades, scientific understanding of the factors that control behavior has enormously improved. Now, for the first time in history, man is able to design a system of cultural control that does not rest on ancient formulae.

Unfortunately, the possibilities for scientific design of cultural practices have not been greeted by the public with enthusiasm. The first two papers in this final chapter deal with some of the causes of the concern and alarm raised by the prospect of more effective cultural design. The first paper is by R. E. Ulrich and is entitled, "Behavior control and public concern." Ulrich points out that much of the concern felt by the public rests on two misconceptions. First is the feeling that, because control is not explicit, it does not exist. A second misconception is that explicit control must rest on aversive stimuli. Because so much of the formal control exercised in our society is based on aversive stimuli, people are unable to conceive of a form of systematic cultural control that is not aversive.

Many of the effects of cultural control as presently practiced are decidedly unpleasant. Cultural design could enormously improve the human condition. Unpleasant possibilities do exist. Increases in knowledge of the causes of behavior could be used to devise new and more effective methods of aversive control. Or, the understanding might be used to produce behaviors that traditional human values deem undesired. However, knowledge cannot be unlearned, nor can the accumulation of knowledge be turned off abruptly. Unpleasant forms of control can best be avoided through increased knowledge of the principles of behavior. The only real choice is between the blind, random, often aversive control of the present, and cultural control that systematically insures positive, rewarding social experience.

The very nature of behavioral control provides some safeguards against possible abuses. In a paper entitled, "Justified and unjustified alarm over behavioral control," I. Goldiamond examines some of these natural limitations. One important aspect of behavioral control is its inherent reciprocity. This reciprocity is exemplified by a cartoon showing a rat in an experimental

chamber announcing that he has the psychologist trained to drop a food pellet into the chamber after he, the rat, presses a bar (Holland, 1960). In this book, examination of social relationships has shown that any ongoing social relationship requires some reinforcement for all parties. The organism who controls the discriminative stimuli in an authority relationship must also reinforce the organism being controlled. The authority is not free simply to demand behavior in the absence of reinforcement. The very nature of the controllee's behavior places controls on the controller. One of the features of alarmist pictures of behavioral control is an apparent separation of the controller from the controllee. In actuality, all organisms are in the same behavioral soup. Inequalities can result, and reciprocity can involve aversive stimuli, but one-way control of one organism by another can never be complete. Indeed, further examination may determine that relationships that maximize positive reinforcement for all individuals represent the most effective, long-term method of controlling behavior.

Another ameliorating aspect of behavioral control is the control that an individual can achieve over his own behavior. Effective self-control procedures are made possible by increased knowledge of the principles of behavioral control. As knowledge of the factors that control behavior becomes available to more people, the control of an individual's behavior, by himself rather than by an external agency, can increase. Many people mistake ignorance of the factors controlling their behavior for personal freedom. Man has for centuries had difficulty in resolving his desire for an orderly universe with his notions of personal freedom. The difficulty has been especially troublesome to Christian theologians who have tried to accept, for example, both divine omniscience and free will. Recently, "freedom" has been sought in those aspects of behavior that have not yet been, or perhaps cannot be completely understood. Natural limitations may exist on the ability of science to understand, simultaneously, various aspects of behavior. The process of studying behavior may itself modify certain aspects of behavior. Thus, science may never be able to describe and analyze every aspect of the behavior it seeks to understand (*see* Grünbaum, 1952; 1962). However, inaccessibility of controlling factors to scientific understanding in no way modifies the control that the factors may actually have over behavior. In any case, uncertainty and randomness seem unsatisfying as definitions of "freedom." From a scientific point of view, the best approximation of personal freedom can be achieved through understanding one's own nature as a human being and learning to exploit it. Increase in knowledge and dissemination of the principles of behavior should actually increase personal freedom.

Finally, Goldiamond points out that technology has never been used to *completely* control anything. Behavioral technology should and probably will be applied to problems especially troublesome to our society or used to create

new behaviors especially beneficial to our society. Behavioral technology is not likely to completely regiment anyone's environment.

One problem in the cultural control of behavior is that of establishing goals or values. Behavior is already controlled according to various value systems. However, the scientific control of behavior will probably require a more explicit value system. In any scientific procedure of behavioral control, the behavior desired must be specified. Also, an explicit, scientifically based value system could offer protection against the forms of behavioral control that would presently be found aversive. The behavior of organisms can help determine values. Given a choice, an organism will probably emit behavior controlled by positive reinforcers rather than behavior controlled by aversive stimuli. Other preferences of organisms, perhaps for certain schedules of reinforcement, should provide useful information. Current, or hedonistic preferences can be balanced against ultimate consequences, both to the individual and to the group. Social values are currently developed through pressures from various elements of our society. Knowledge of behavior can provide another source of information to help develop values that are most consonant with our nature as human beings.

The relationship of man's nature to cultural design is examined in the final paper presented in this book, by B. F. Skinner and entitled, "Contingencies of reinforcement in the design of a culture." Skinner shows how cultural design may be used to modify one troublesome aspect of man's behavior. Biologically, human organisms were designed for an environment in which reinforcers were scarce. Man's technology has made reinforcers abundant for many people. Man's sensitivity to positive reinforcement, combined with the ready availability of many reinforcers, has made many people fat, alcoholic, and addicted to cigarettes. Skinner presents several approaches to cultural design that can be used to minimize this effect.

Skinner's analysis exemplifies the approach to cultural design that the editors feel should be taken. To many people cultural design means passing a law. An extreme form of this attitude was displayed by a legislator who, wishing to control illegitimate births, proposed a law that made the birth of a third illegitimate child a felony. Many of the problems in society can be remedied, not by punitive measures, but by changes in the institutions that regulate behavior. Schools can make much stronger use of positive reinforcers. Welfare systems can be careful to use their reinforcers only to strengthen behaviors beneficial both to the client and to society. Increased knowledge of the principles of behavior by the myriad individuals who control the myriad stimuli of American society, could make social experience far more pleasant and effective.

In short, the prescription for whatever ills may attend the cultural control of behavior is an increase in the sort of knowledge of social behavior presented in this book. A *laissez-faire* approach to social interaction merely leaves control to random factors. Scientifically unfounded ideas on the nature of social behavior simply misdirect resources. A widely disseminated, scientifically based knowledge of the factors that control social behavior is needed to bring the cultural control of behavior out of its current medieval mire and into the twentieth century.

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Behavior control and public concern

Roger E. Ulrich

Over the years behavioral scientists have worked from the premise that human behavior, like other natural phenomena, can be lawfully described by functions which relate environmental events to behavioral events. Through experimental analysis, laws of behavior have been derived which have increased man's understanding of his own nature far in excess of what was once thought possible. Careful laboratory studies, first with animals and later with men, have slowly built up a store of knowledge which eventually allowed for the extension of both method and principle to settings beyond the confines of the laboratory. Educational institutions, outpatient clinics, mental institutions, advertising, business, industry, and the military have all felt the influence of the technology of behavior control (Ulrich, Stachnik and Mabry, 1966). In spite of, and because of, the success of the scientific approach to human behavior, there has been considerable resistance to its application and development. Many individuals are, for a number of reasons, often reluctant to admit the possibility of being controlled by outside forces—a reality for which science is supplying increasing substantiation.

One indication of the popular concern with human prediction and control is evidenced by the current interest in such books as *The Brain Watchers* (Gross, 1962), *The Hidden Persuaders* (Packard, 1957), *1984* (Orwell, 1949), *Brave New World* (Huxley, 1932) and *The Manchurian Candidate* (Condon, 1959). The fact is often overlooked that many of the popular books on this subject depict a type of control whose methods and aims would be denounced by practically the whole of our present society. The control of behavior is usually lumped into one unsavory package with little thought to the many beneficial ways in which it can be used. If it is admitted that humans can

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control other humans then arguments are heard concerning the practical and moral implications of such power. Who has the right to control whom? How shall we determine our goals? How can we select one man or a group of men to control the behavior of their fellows? What happens if malevolent individuals seize such power? Although these questions certainly reflect legitimate concerns, innovation has never been free of attendant challenges, and the question still remains, is there a cause for the occasional aura of pessimism and alarm which has been attached to the future of behavior control?

Before attempting an answer, let us define the issue more clearly. What is behavior control? The control of behavior may be simply defined as the manipulation of the environmental conditions to which an organism is exposed so as to bring about a definite behavioral result: to produce new behavior, or to maintain or eliminate the organism's tendency to engage in current behavior. Based upon such a definition, the question of whether or not human behavior is controllable should no longer be an issue. Countless examples bear witness to the fact that man's behavior can be predictably manipulated. One of the most striking examples concerns personal tastes in clothes. Every few years, many individuals find themselves throwing away ties which they once thought handsome. The devotion of both women and men to the fashions of the day is thus a conspicuous illustration of environmental control. Quite simply, our environments are constantly being arranged so as to manipulate buying behavior. We also find environments structured so that children learn specific languages, learn to feed and clothe themselves in a particular manner, and learn to attend one church as opposed to another. To assume that individuals personally have control of the situation independent of the conditions imposed by advertising, salesmen, wives and teachers, is most unrealistic.

Although the behaviors mentioned above have been affected by outside forces, particularly forces manipulated by other individuals, they have not typically produced a great deal of concern. This is perhaps due to the fact that the techniques used by many controlling individuals or agencies are not aversive in nature. The issues that produce concern seem to be primarily related to behavior which is controlled by events characterized by their aversive qualities. People do not appear to be as opposed to behavior control which involves the use of positive reinforcers contingent upon a response. In this case, they are likely to explain that they engage in the behavior because they "want to." However, if that behavior is controlled by presenting a noxious stimulus for failure to respond, many individuals are likely to say that they engage in the behavior because they "have to" or are "forced to." The animal conditioned to press a bar to escape shock displays more behaviors that might be described as "angry" or "aggressive" (Ulrich, 1967) than does the one who is induced to press a similar bar through the use of positive reinforcement (Skinner, 1953). Both instances involve behavior control; the aversive case is far more likely to cause concern than the non-aversive one.

A good example of alarm related to aversive control of behavior was

supplied by a pretty blonde sophomore in an introductory psychology class. She was very critical of the control exemplified in Skinner's *Walden Two*, (1948). "Sure, it's fine," she said, "when man uses the techniques of behavior control to change a psychotic or a criminal or to help in the education of a student. What worries me is the possibility that one day some controller may decide that all blondes will be caused to respond in a particular way, a way I despise, but can do nothing about. Just the chance of this occurring makes the prospect of greater behavioral control frightening. I'll have none of it."

It is agreed that the situation she described would indeed be alarming. We can envision a day, far off in the future, when the fruits of the mad behavioral scientist will be ready for harvest. A controller is pictured saying to the little girl, "You have blonde hair and light skin. Therefore, we who are experts at manipulation of environments are going to arrange yours so that you will not be allowed to go to certain toilets, certain water fountains, certain restaurants, certain motels, and to certain schools. You will not be permitted to live next door to others, except of your own kind, and most certainly you will never be our sorority sister."

Of course, there are areas of behavior control about which we should become concerned. When we impose controls which lead children to grow up in slum environments where there is no educational interest or materials of any kind, and later punish them because they act like uneducated slum dwellers, there is cause for concern. When a society continues to allow religious and cultural dogma to dictate practices which inhibit the control of a population expansion which, if not checked, will guarantee its own extinction there is cause for concern. When a controlling government manipulates man's passions so that he gladly rushes to war against other men with similarly manipulated passion—there is indeed cause for great concern.

Although the potential dangers of behavioral control are admittedly worthy of careful consideration, the majority of debates which attack this question are in actuality missing the point. Too much time continues to be consumed by the issue of whether behavior control can or should be effected. Men *can* and *do* control the behavior of other men—this should no longer be the issue. We as a culture must begin to accept the assumption that man is a lawful organism and that the control of human nature is a ubiquitous fact. Questions of goals, methods and choice of practitioners are of extreme importance, but are premature if used as arguments against its implementation.

Following the fundamental acceptance of control, it is then critical that our energies be directed toward the question of how the use of this control can be made beneficial for our own effective evolution. The alarm over both theoretical and practical issues has unfortunately discouraged some psychologists from the full recognition and use of the powers of their science. There has been some feeling that the actual application of the scientific control of behavior, especially as pertains to human values, should be withheld until

goals and restrictions have been made more explicit. But why should scientists refrain from actively working to effect cultural ethics when politicians, advertising men and ministers freely do so every day? If we refuse to apply our knowledge of behavior, we are not simply taking a neutral position. Rather, we are endorsing other forms of control which gain in potency as we withhold the competition offered by our methods. If we ignore or eschew our responsibility, it will not go away any more than public ignorance will affect the disappearance of behavior control itself. We obviously do not as yet have a scientific answer to questions such as who should practice behavior control, what methods are preferable for controlling behavior and what are the behavioral goals we should seek? Perhaps research will someday yield reliable criteria that can be used to help decide which individuals will control which behaviors. In the meantime, however, practitioners of behavior control will continue to be produced by what are, simply, the haphazard conditions provided by a society that for the most part has not faced the issue.

Certainly universal agreement as to what precisely is "desirable," "appropriate," or "beneficial" responding on the part of a given individual in our society is difficult to obtain; nevertheless the difficulties which we forsee should not keep us from making the first step. Let us instead remind ourselves again to accept the facts surrounding our own behavior; i.e., we tend to respond in a way that is reinforcing to us and to quit responding when the major effect of our behavior produces pain. It is this fact, however, which produces much of the conflict related to the human control issue. Each of us is afraid that what is reinforcing to the other might be painful to ourselves. An ideal behavior that one might hold dear and work diligently to promote, may be diametrically opposed to what another finds reinforcing. With the wide divergence between individual experiences, this seems an unalterable fact. We thus see individuals responding in ways that tend to change the behavior of persons with whom they disagree, but frequently not admitting it. Others actively steer away from control. However, as mentioned previously, if we find it aversive to apply modification techniques, we are immediately placed in a compromised position, and are by default, condoning alternative techniques. Let us admit that we are all, in fact, engaged in the practicing control and countercontrol techniques, according to the conditions imposed upon us by our environment. The winner in any struggle to direct the behavior of other men is the group, who by either accident or design uses the best techniques of behavioral modification and control. There are many persons in our society demanding that certain changes be effected in human behavior. The nature of the changes, however, will be determined by those who effect to the largest extent, the controlling contingencies. Hopefully the system of "checks and balances" already evolved will continue to improve and will mitigate against behavioral practices which in the long run are detrimental to our own satisfactory evolution. Debate concerning the morality of behavior control should be replaced with experimentation, both basic and applied, designed

to better determine immediately the behaviors necessary for approximating a reinforcing existence for all. Rather than cry out that it is morally wrong to control human behavior, we should consider it morally wrong to allow the continuation of what is at present an ill defined and unstructured evolution of cultural practice. The time has come for us to be alarmed over the ethic which dictates that our techniques of control should be dissipated. We worry about our behavior and we worry about who should control it. But worry is a poor substitute for action. Indeed, a far better tactic has long since been provided in science which suggests that we should no longer wait before arranging conditions which will at least promote an experimental analysis of those questions concerned with establishing a more universally reinforcing society.

The control of human behavior is a fact. Pretending that it does not exist will not make it go away. Individuals concerned with personal freedom should at least consider that perhaps the only meaningful form of behavioral freedom must be based on a knowledge of the factors which, indeed, control us. As man comes to know more and more about causative factors, he acquires a new type of freedom which makes self-control truly possible. So long as man is not aware of the factors which determine his behavior, his ignorance places him in the position of being easily subjected to the control of other people, or of other environmental circumstances. This fact is not, as some contend, the "fault" of the psychologist (Miller, 1966) whose behavior is also a function of environmental conditions. External events have caused the psychologist to probe human behavior and discover functional relationships which are constantly increasing man's ability to predict and control other men. Perhaps in recognizing some of the facts of behavior control, we can begin to use the methods and principles of the science of behavior so that fewer people will continue to exist in the bondage imposed on them through a lack of understanding of the conditions which indeed dictate their lives.

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Justified and unjustified alarm over behavioral control

Israel Goldiamond

Concern is currently being expressed over the possibilities of control of human behavior in the same sense that other natural phenomena are currently being controlled. The causes for this concern are varied. One form of concern involves the replacement of man by the control devices he is creating. Such concern during the early Industrial Revolution led to action by the Luddites, who smashed the machines which were replacing them. At the other (literary) extreme, machines replaced man in Capek's post-World War I drama, R.U.R. (Rossum's Universal Robots), which introduced the term *robot,* from the Slavic root for work. (The human race, however, was re-established since, in the process of producing progressively more human robots, the scientists had produced a pair with procreative powers, an Adam and Eve.) The new cybernetic revolution of the last ten years, with its resultant automation, is producing another surge of technological unemployment. Our concern with this technology of decision and control functions will not be with this aspect but rather with its effects upon a science and technology of behavior. These are currently being perceived as threatening the robotization of man and as creating the possibility of his being controlled, thereby losing his freedom.

The cybernetic and electronic discoveries of the past decade have provided new instruments and methods of investigation which enable us to ask new scientific questions and, often, to get new answers. The effects of such investigative tools upon science may be exemplified by the microscope, a trivial application of optics once magnification was known. There was nothing in the history of medicine which could have logically predicted such an instrument since it arose out of developments in the unrelated field of optics. Nevertheless, this instrument enabled Pasteur to ask questions about small

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forms of life and to find the answer now generally known as the germ theory of disease. Without such instrumentation, the theory would have been merely speculation. New developments in the instrumentation of today are providing tools for asking questions which could not have been stated before. Included in the "spin-off" from space research, where miniaturized equipment is generated by the space constraints of space vehicles, has been equipment currently being implanted in living organisms for purposes of analysis and control. Turning to more mundane developments, new instruments created in electronics and allied sciences have led in many areas to having control of behavior replace its prediction. The relay provides for instantaneous delivery of reinforcement, and the relay rack and various open-faced switching circuits provide the opportunity to associate these reinforcements in a very literal way with a variety of behaviors and other conditions and to schedule and program these events.

That behavioral control is with us is no longer debatable. Chimpanzees are currently being trained in binary notation and are solving problems their species had never encountered before (Ferster, 1964). Man is not only becoming a geological force but may also be becoming a zoological one. We may well ask why humans have difficulty with such mathematical languages. The process of programming such changes in chimpanzees may provide clues for application to humans of linguistic and mathematical problems. We have not only had our astronauts but also our astrochimps, whose behavior in space was controlled by scientists on earth—a kind of telecontrol which involved procedures drawn right from the book (Rohles, Grunzke, and Reynolds, 1963). Pigeons have been trained for quality control in the selection of pills and other products (Verhave, 1959). They, thereby, replace human quality control and create the possibility of what might be called "bestiological unemployment." We have heard of programmed instruction and forthcoming changes in education. These are often extensions from animal research of the type described. Very recently, related procedures were applied to students from the lowest third of their graduating high school classes in a state university in an effort to restore them to the academic community (Cohen, 1964). Currently, projects are under way involving the controlled alteration and elimination of stuttering (Goldiamond, 1964) and behavioral deficits such as autism in children (Ferster and DeMyer, 1961). Extensions are being made to marital and scholastic counseling. A ward in a mental hospital has been out under similar environmental control, and some of the patients are now working as attendents in other wards (Ayllon and Azrin, 1964; Mishler, 1964).

A textbook on theories of learning (Hilgard, 1956) remarks that of all the theories of learning in the book, Skinner's position is the only one whereby the instructor can take an animal and train him to perform directly in front of a class. The author wonders to what extent this demonstration of control will prove applicable to human behavior. The caveat now turns out to be unnecessary. Indeed, we recently directly applied to children a new laboratory

procedure whereby pigeons were taught very rapidly to discriminate forms which had hitherto taken thousands of trials (Terrace, 1963a,b). In this case, preschool children were taught, almost without error, to discriminate forms and letters whose learning was otherwise accompanied by errors and failures (Moore & Goldiamond, 1964). The procedures could also be extended to the establishment of errorless discrimination of verbal concepts by adults (Goldiamond, 1964).

Such books as Huxley's *Brave New World* (and his revisit), Orwell's *1984*, Skinner's *Walden Two*, and Krutch's *Man the Measure* take sides with regard to the possibility and implications of control of human behavior. The concern over control may be classified according to the following issues:

(1) Is control over behavior possible? That grave implications are perceived in this possibility suggests that to many authors the possibility is an actuality, either at present or in the not-too-distant and science-unfiction future.

(2) If such control is possible, can it be used, on a practical level, to make man perform acts in the interests of the controller and, especially, where such interests are against his own? A subsidiary question is whether such control can be used socially to produce conformity, automation behavior, and behavior, and robotization of man and his society.

At least two assumptions are corollaries of the latter subsidiary question. These are that (a) man's past technological advances in the natural sciences have produced homogeneity and uniformity in the fields in which they have been applied and (b) it is to the interests of a social controller to produce automaton behavior.

The perception of control as related to conformity, which is implied in the subsidiary question raised, may be related to the equation of freedom with individual differences and, with the equation of scientific control, with the absence of freedom. This raises the third issue.

(3) If such control is possible, what are the philosophic implications with regard to human nature, man's conceptualization of man, and man's treatment of man? As was indicated in the foregoing paragraph, one set of implications may be drawn if certain assumptions are made relating freedom and individuality and freedom and control.

These questions are often raised against a background of man's struggles against tyranny and changing philosophic views of man, which are considered relevant to present-day social problems and procedures for their alleviation. They have also become entangled in the issue of determinism and responsibilty. An important newspaper, for example, recently editorialized that a major factor responsible for current immorality was acceptance of the philosophy of determinism. Social scientists were considering the behavior of lawbreakers as being environmentally determined. The lawbreakers were, therefore, not being held accountable for their actions; the ensuing absence of punitive measures was increasing lawlessness.

A philosophical paradox which has been raised as a kind of divertissement is: if man's behavior is determined and can be controlled by a controller, is the controller then an exception? What controls him? While this may be a philosophical paradox, on a practical level it has been suggested that social control be established over him. The possibility of a moratorium on research in behavioral control has also been suggested, a kind of twentieth-century Luddite movement.

The arguments to be presented in the current discussion are that much of the alarm generated is irrelevant to the issue of the scientific control of behavior; the alarm may be based upon a misunderstanding of the nature of the science of behavior itself; the implications of these advances have not only eluded literate members of our society but often those literate members of our society known as scientists. Another contention of the present discussion will be that the alarm which is expressed may be based upon an extension from formulations in psychology which preceded the advent of the current decade and which may be obsolete at present. Had these formulations held up, then the cries of alarm would have been only too justified. Stated otherwise, if the recent developments, where control is demonstrable, were a logical outgrowth of previous systematizations which lacked such control, then there would be cause for alarm. Developments in science and in other areas as well have a way of leaving their systematizers behind, and I hope to document this assertion in the course of this argument.

Fundamentally, the issue can be related to C. P. Snow's (1959, 1963) postulation of two literate audiences. One of these is the scientific audience, and the other is the standard literate audience. There is an intransitivity between the languages they speak: if the physicist does not understand the novelist, it is because he does not read him. But he could understand him, were he to read, as many do. His training has included the possibility of such understanding. If the novelist cannot read the physicist, it is because he cannot understand him. The differences in their training has precluded such understanding. An example of the differences in inclusiveness of training is cited by Isaac Asimov, who not only writes charming science fiction but is also an excellent chemist. He reported a recent university faculty meeting where one of the English professors stated: "After looking at my roll today, I discovered a John Milton in my class." Everyone laughed. A physicist then remarked: "Now, isn't that a coincidence. I have a Frederick Gauss in my class." Only the scientist laughed. This is an easily remedied difference in education, but other differences in training are not remedied as easily. Scientific conclusions have a way of getting themselves written in the mother tongue, and a literate reader may assume that he understands the conclusion, inasmuch as it is written in English and conforms to the laws of grammar which he has been taught as well as the scientist. However, *the acceptability of any scientific conclusion must rest upon the validity of the empirical and logical procedures used to obtain that conclusion,* and very often the only person capable of ascertaining the

validity of procedures used is someone engaged in active research in that area. This has created islands of noncommunication within scientific disciplines as well as between the two cultures defined by Snow. Presenting a stimulus for 2.05 seconds may make all the difference from presenting it for 1.00 seconds. What may seem to be an alarming conclusion may turn out upon examination of the procedures used to obtain them to be either trivial or inconclusive. The literate person (and the other-islander scientist) may be at the mercy of faith in the written word or what friends he consults in any scientific controversy.

SUBLIMINAL PERCEPTION

As the first case study of this type of difficulty, and one which bears upon the present issue of behavioral control, we shall present the issue of subliminal perception. It will be recalled that about seven years ago, the possibility was raised that somebody might, using a screen, or radio, or television, project stimuli too faint to be seen or heard but which would, nevertheless, control or influence behavior. More than one company was formed to exploit this possibility, which was called subliminal perception—the word "subliminal" being the Latin term for "below the threshold." The hue and cry was immediate. The *Saturday Review of Literature* (1957) devoted a full-page editorial to the subject, stating that the subconscious mind was not to be sullied to increase the sales of popcorn. In indignant terms, it urged that the apparatus be put on a warhead of an atomic bomb and exploded on the Bikini atoll. The *Christian Century* (1957) warned ministers not to use this nefarious device, even for such good ends as subliminally flashing: Rally for Christ tonight. A commission was formed by the legislature of a prominent eastern state, to investigate this possibility and the need to protect its citizens (1959). In contrast to the alarm expressed by these humanistic quarters, the technical journals, by and large, stuck to the facts, reporting the results as claims made by their proponents.

This alarm was clearly related to classical formulations written in language which has now become part of our literate culture. For example, Fenichel (1945) related unconscious phenomena to experiments in subliminal perception, which area William James (1902) considered as one source of material leading to mental "incursions . . . of which the subject does not guess the source, and which, therefore take for him the form of unaccountable impulses to act." Understood in terms of this background, commercial exploitation of subliminal projection does pose a grave threat, and one newspaper writer raised the possibility of its use in political campaigns. These are members of our literate culture. An analysis in terms of recent advances in the branch of perception known as signal detection (Swets, Tanner, and Birdsall, 1961; Goldiamond, 1958, 1962) involving an understanding of the experimental and logical *procedures* underlying the research, provides an

interpretation considerably at variance from the claims of the commercial would-be exploiters and from the understanding of the literate audience which accepted them.

Where is subliminal perception today? What happened to it? Why is it not being used? The conclusion that subliminal perception could be used in the manner indicated by its commercial sponsors *was not validated by the procedures used to obtain those conclusions* and involves technical excursions into the Theory of Signal Detection and mathematical decision theory which are beyond the scope of this paper. Nevertheless, in common language, if we examine the procedures of subliminal perception carefully, we discover that the experiments can be subsumed under the following paradigm: The experimenter asks the subject if he perceives a stimulus, which is decreased in magnitude or duration, until the subject says "No." At that stimulus level or below it, the subject is required to respond some other way. This behavior demonstrates that he is still being influenced by the stimulus. The occurrence of such influence upon his behavior at a stimulus level which he reports is unperceived is interpreted in what seems to be a straightforward manner, namely, that the subject can be influenced by what he does not know or does not consciously perceive. Stated otherwise, he is capable of being influenced unconsciously. This interpretation makes several interesting assumptions: that the subject can define what he perceives, that when he reports this he has exhausted his definition of his perception, and that such report by the subject validly defines perception to the experimenter. Another assumption is that there is such a thing as a threshold, and another is that there is such a thing as a subconscious mind. Finally, it is assumed that the procedures link all of these.

In actuality, the data can be explained not only more parsimoniously but in a manner which leads to producing the behaviors desired, by reference to two different classes of behavior. One class involves stating that the stimulus was perceived or unperceived. Another class involves describing the stimulus or reacting to it in some way other than such report. Although both classes of behavior will vary as the stimulus is being varied, they can also be manipulated independently of each other and of the stimulus. Stated otherwise, they are governable by different variables. It is as though a voltmeter and ammeter were in line on the same varying current. The voltmeter had an *additional* variable, namely, some steel filings in its bearings. At a high current level both needles moved, but at a low current level only the ammeter recorded, since the voltmeter was stuck at this point. This would give us the extraordinary phenomenon of *current without voltage*, exactly parallel to the *discrimination without awareness* of the subliminal research. In physics, no one would rush into print with this unusual finding but would seek to investigate what variables were involved. A similar procedure is required in the analysis of behavior, and labeling the phenomenon unconscious is no substitute for an explanation. As was mentioned earlier, such an explanation

has been provided by the Theory of Signal Detection, which is an outgrowth of classical psychophysics. Interestingly, the work of Fechner, one of the founders of psychophysics, was regarded as trivial by William James (1890), and the field was derogated by others as "brass instrument psychology." The suggestion here is that the current lack of communication between literary culture and scientific culture, which defines its phenomena in relation to its procedures (brass instruments), was also characteristic of the last century. This has been noted as well by Snow. What is more relevant to the current discussion is that by rejecting the scientific procedural language, as James did, the literary culture may lose some ability to evaluate the impact upon society of a developing science and technology and may become alarmed when there is no cause or may be quiescent where there is cause. In all events, it may not be able to evaluate the validity of the conclusions reached by investigators—James regarded each research in areas related to subliminal perception as among the greatest advances and potential contributions to the young discipline of psychology.

The misunderstandings are further complicated. The case of subliminal perception cited rests upon the assumption that a stimulus has a kind of simple mechanical control over behavior. This assumption is often made in other areas of communications as well. We are told that if only our propaganda were correct, we could influence foreign nations. If only we could use the appropriate language, if only we could state our advertisements appropriately, if only we would use the appropriate colors or the appropriate lighting, then we could "sell" the behavior we want. John Milton, in contrast, wrote in prison, under highly inappropriate conditions, but, then again, he was an exceptional person. What may be involved in this ubiquitous lawfulness which is accompanied by exceptions granted to exceptional people is a confusion between early formulations of respondent conditioning and current operant research, which continually recurs in discussions of brain-washing, another form of control.

It will be recalled that Pavlov got a dog to salivate by pairing a tone with citric acid, and after many pairings of these two the tone alone elicited salivation. It was then assumed by some interpreters that this was the scientific explanation of association and that if association of stimuli was appropriately handled, one would get the appropriate behavior. The human organism, or for that matter any other organism, was considered a simple device governed by this simple stimulus-response relation. The appellation, *S-R psychology*, was given to this position; like *brass-instrument psychology* it had pejorative connotations and was rejected by many members of our literate culture. This rejection was extended to an experimental psychology allegedly based on S-R relations (but, interestingly, implicit acceptance of the S-R relation explicitly rejected by the literate culture underlay its alarm over subliminal perception). In actuality, this is a misinterpretation of much of experimental psychology, including the Pavlovian branch, which rejects the S-R relation

given as an oversimplification. Such rejection by experimental psychologists also enters into their questioning of subliminal perception.

As the Theory of Signal Detection indicates, things are not quite that simple, even in perception. The perceptual response in a threshold task is not in simple relation to the stimulus presented for judgment. The response is also governed by its consequences, like any other decision. The experimenter may manipulate the consequences, using a decision matrix, and thereby obtain any number of thresholds for the same stimulus presentations.

The analysis of behavior in terms of its consequences is the subject of much research in operant laboratories, which we shall now consider. It is the successful application of operant research to various human and animal behaviors that leads us to Case II of the hue and cry over the control of behavior.

OPERANT CONDITIONING

Operant behavior is defined as behavior whose rate or form is governed by its consequences. For example, a pigeon pecks at a disc. If, when the disc is pecked, food is produced (the pigeon having been deprived of food for a considerable amount of time), then the rate of pecking will be observed to increase. If food is not produced, then the rate of pecking will decrease. Some consequences may increase behavior, and some may decrease them. Nature is often merciless in its application of these consequences. The child learning to ride a bike exemplifies this. If he leans over too much in one direction, the consequence will be falling. If he moves his front wheel in the direction of the fall, the consequence will be staying erect. In a short time, the appropriate behaviors will be established, and we state that the child has learned to ride. Considerable lawfulness has emerged from the laboratory where these phenomena are studied under carefully controlled conditions. In the laboratory, a specified response is stipulated, and the equipment is set up to schedule consequences of different kinds immediately and in different sequences and with other variations so that relationships between the consequence, the behavior, and the other conditions can be carefully analyzed.

A characteristic of most operant research which is particularly relevant to the current alarm is its use of *control*, rather than *prediction*, to validate its findings. Related to the use of control rather than prediction is the emphasis upon *procedural* control rather than *statistical* control, and the use of *single* organisms rather than *groups*. The predictive-statistical-groups procedure when applied to a question of learning, might attempt to validate a theory by predicting from it that a certain variable would affect learning (therapy, or what have you). Two groups of subjects might be run, which are differentiated on the basis of the variable. If one group averages, say, 60 percent on the criterion behavior and the other 75 percent, and the difference be-

tween them is statistically significant and in the right direction, the theory might be considered validated. The control-procedure-individual approach, applied to the same problem would be an attempt to answer the following question: How can we get *every* single organism to attain 100 percent of the criterion behavior? The emphasis is on procedures which produce the results required in each case, rather than predicting what the average will do, with a given individual's behavior indeterminate. This, of course, is control, and it is this aspect of operant research which has made it amenable for application to the solution of practical problems and which bids to establish a technology of behavior in the same sense that technologies have developed in the natural sciences. The control established may be utilized to gain theoretical knowledge. Once the phenomenon is under control, that is, it varies in functional relation with the independent variable, one can attempt to describe the lawful relation, its relation to other relations, and the constraining conditions under which it holds. If such analysis is unsuccessful, procedures for change and control are nevertheless bequeathed to their wielder. There has been lamentation in recent psychological journals that few studies are repeated. Operant conditioning research is characterized by such continual repetition, inasmuch as procedures developed in one investigation are incorporated into the next.

At least one law or major generality has emerged out of such research. This is the procedure of Differential Reinforcement. What this procedure states is that if different reinforcements (A and B) are systematically applied to different behaviors (a and b), then there will be differential effects upon the rates or other descriptions of that behavior. For example, one can get pigeons who normally peck on the ground to peck high in the air. This is done by supplying reinforcement whenever the pigeon raises his head and not when he lowers it. Eventually he will stretch his head and peck like a woodpecker. In this manner, a variety of skills can be programmed. One can also attach differential reinforcement to the same response in the presence of different stimuli. For example, if when the disc is green the peck is reinforced and when the disc is red the peck is not reinforced, the pigeon will quickly come to respond when the green light appears but will not when the red light is on. He who controls the light switch can control behavior—getting a peck when green appears and none with red. We can also attach differential reinforcement to more complex cases in which both different behaviors and different stimuli are systematically related, as when different behaviors are appropriate for different conditions. Various types of reinforcements have been used, such as food, water, sex, words, money, attention, change in temperature; the recent use of electrical brain stimulation has led to all kinds of lurid pictures in popular magazines. Varieties of subjects have been used, ranging from frogs to people, and varieties of behavior on a human level have been altered, ranging from tics to reading.

Considerable attention has been devoted to the variables and conditions

maintaining ongoing behavior, and precise relations between behavior and the environment have been established. To elucidate these relations, a controlled environment has been established, in which extraneous fluctuations have been minimized. For a pigeon, this is the familiar insulated picnic icebox. Use of such highly controlled environments has led to the conclusion that in order to get the behaviors we want, we need a highly controlled environment (i.e. a box, or, on the human level, a prison cell). Since such control is generally unavailable, there have come about, on the one hand, a questioning of the applicability of operant procedures to less controlled conditions and, on the other hand, a quest for more control in applied situations.

At the Institute for Behavioral Research, we have been treated to two extremes on the control continuum. One has involved Project ECHO, Environmental Control Human Organism, in which a human being lived for five months in a large controlled environment made habitable from a walk-in ice box, the logical extension of the picnic box for the pigeon (Findley, Migler, and Brady, 1964). The other has involved a departure from such complete control and observation.

In the experiment in which chimpanzees are taught binary arithmetic (Ferster, 1964), two chimpanzees live in a considerably uncontrolled environment. They have a space larger than in most zoos, in which they swing, jump, and engage in free activity. When, however, one wants some food from his environment, he must work for it. To do so, he enters a small screened enclosure on the premises and works at binary notation. Successful solution provides food; when he wishes to, he leaves. The other animal is visible and often engages in vigorous behavior while one animal works. This situation is quite similar to that of the native African habitat. If a chimpanzee wants a banana, he must approach it in a certain way; and if he wants a nut, in another way. The ways in which he approaches a banana are governed by the past symbiosis between chimpanzees and bananas. In the present case, the relationship of the chimp and his environment is being programmed by man, rather than by accidents of evolution, and this involves learning binary notation.

Environments which require complex behaviors may generate such behaviors, and those requiring simple behaviors may generate such behaviors. In our laboratory course at Arizona State University, students work to shape individual rats. After two weeks, the rat picks up a marble upon call and carries it to an appropriate place. Often, in every class of thirty-two, two students will state that they have a feeble-minded rat who cannot learn. The rat is then given to a better team of students, and the rat is found not to be feeble-minded after all. Similarly, Harold Cohen, chairman of the Design Department at Southern Illinois University, took students who were in the lowest third of the high school class and who would have not been normally admitted into the university system of Illinois. He set up a special

environment for them and made rather strong demands in terms of the number of books read, records listened to, and the like. The students responded rather well to this challenging environment. Procedures which were derived from the animal laboratory, to maintain study behaviors, were successfully applied.

BEHAVIORAL ANALYSIS AND CYBERNETICS

Can we program the environment to get the behaviors we want? This is one of the critical questions of this day. The environment can be programmed to produce stupid behaviors and can also be programmed to produce highly complex behaviors. One of the basic problems involved is to define the behavior we want in a manner which enables us to work with it. It is here that behavior analysis and cybernetics have a commonality. The age of cybernetics can be said to have started with the definition of thinking. Rather than defining thinking in terms of processes imputed to the thinker, the original group decided to define thinking in terms of the behaviors of the observers. Stated otherwise, the cybernetic definition of thinking was: What does a person have to do, and when, for us to state that he thinks. Or, stated more formally, *what behaviors under what conditions define thinking?* A machine could be constructed which exhibited those behaviors and which thought, by this definition.

One investigator may define thinking as the occurrence of behavior A under condition Z. Another may define thinking as the occurrence of behaviors A, B, C, under Y, Z, a broader definition than the preceding one. They both, however, define thinking in terms of the observer rather than processes of the thinker. Elsewhere, I have called this approach the Basic Behavioral Question. This Basic Behavioral Question can be applied to areas other than thinking. It can be applied to memory (producing as an output, upon call, certain inputs previously presented, by which definition, libraries and record players are memory devices). It can be applied to visual perception (differential responding to reflected wave lengths, by which definition, radar networks see), to decision-making (optimizing net gain in accord with a specified matrix, by which definition an advanced computer system can decide), and to other "higher mental processes" in general.

The Basic Behavioral Question is also shared by modern behavioral analysis or a newer behaviorism. It supplies us with a definition of the problem, stated in the terms of the observer. There may be many definitions of a term which share this approach. The different definitions and answers can coexist without conflict since the observations which differ, and which define the term, are explicitly differentiable. The Basic Behavioral Question also supplies us with a criterion to aim for. For example, if we define abstraction as displaying certain specified behaviors under certain specified conditions and the

behaviors do not occur when we establish the conditions, we can then try to develop procedures to get the organism in question to emit these behaviors under these conditions. We can thereby train a pigeon to abstract as defined. To the extent that the definition of abstraction is relevant to the common usage of the term with human organisms, the procedures we develop with pigeons may be useful to develop abstraction in children. By analyzing what it is that maintains such behavior or alters it, we may then learn the variables involved in the maintenance and elimination of such behavior (and processes). Accordingly, we may then not only develop procedures for control but also develop an analysis of the problem; that is, we may develop theoretical knowledge.

Definitions according to the BBQ differ from operational definitions to the extent that they more readily reflect common usage. A scientist may define mother love operationally as the number of kisses a mother gives a child. The Basic Behavioral Questions asks: "When people use the term, *mother love*, what behaviors of the mother are they talking about and what are the conditions under which these behaviors must occur for them to use this term?" The attempt is made to have contact with the usage of the term by the social community. To the extent that the social usage of the term contains undefinable or contradictory elements or is an open set, the Basic Behavioral definition may differ from the social definition; but in that case the social definition may contain questionable elements. To the extent that a technology is unavailable to answer some of the questions raised in the social definition, the BBQ may omit these questions and possibly only temporarily. In this case, the definition suggests what instrumentation is needed. These differences between operational and behavioral definitions may be differences in degree and may pertain only to the more usual use of operationism in psychology, but they can lead to differences in procedures.

Cybernetics and behavioral analysis differ in that in one case we construct a device in accord with the BBQ, but in the other case we are given a biological organism and must change it through what may be some other means in accord with the linguistic analysis. It is probably in this difference that the main limitations upon drawing analogies from cybernetic machine systems to biological systems reside. The machine is constructed, but the organism may be given constraints attached to its reconstruction.

The Basic Behavioral Question may also be applied where the "meanings of the behavior" differentiate them. For example, the objectively similar behaviors of bumping blindly into a chair, are classified as different when engaged in by a malingerer, a hysterically blind person, or a genuinely blind one. If we deal with a BBQ based on topography of the response alone, the behaviors are the same: blindness involves lack of differential responding to reflected wave-lengths within a certain spectrum. However, if we try to alter the behaviors, three different procedures will have to be used. This control definition is implied in the clinician's statement that the difference in mean-

ings of the behavior is important, since differences in meaning will presume different treatments. The behaviors can be said to differ in terms of the consequences which maintain them. The blind behaviors of the malingerer will have the consequence of keeping him out of the Army, and the blind behaviors of the hysteric will have other consequences subsumed under the term "secondary gain." That the behavior of the genuinely blind person cannot be altered by the consequences and that his behavior is not considered a psychological problem suggests that control of consequences is relevant to psychology as defined by clinical practice. There is a further suggestion that the BBQ definition of one of the uses of meaning is the *consequences* of the behavior. Stated otherwise, the study of this use of meaning may involve the analysis of operant behavior.

The approach can be used to answer questions considerably removed from the connotations of automata and mechanism. Let us, for example, examine the term "creativity." Rather than ask what happens to the creator when he creates, let us ask ourselves what characterizes the person whom we define as creative. It turns out that most creative people are (1) highly competent in their subject matter, examples being Einstein, Bach, or Auden. However, competence alone is not enough, since the pedant may also be competent. The creative person is also one (2) who handles his subject manner in a new way. Needless to say, novelty is not enough, although to some educators, who encourage children to "create," this seems sufficient. The combination of novelty with competence is also not enough, since some psychotics are competent in a novel way. The behavior must also (3) tie in with the reinforcements of some community (sometimes a community of one!). Given this definition of creativity, we can attempt to program an environment which will optimize creative behaviors or people who engage in novel responses in their area of competence which tie in with the reinforcements of a community.

FREEDOM AND BEHAVIORAL ANALYSIS

The Basic Behavioral Question can be applied to the definition of *freedom*. In this case, we start off asking ourselves this question: "Given two people, one of whom we agree has more freedom than the other, what are the behaviors and conditions which differentiate them?" A person who is "compelled" does not have many response alternatives available to him during the conditions of his compulsion. We may be able to alter his behaviors, so that when the hitherto compelling conditions are now presented, a variety of responses may occur, that is, more response alternatives are available. When we define freedom in terms of the number of response alternatives available (this is only a partial definition), we can then actually program the environment to increase freedom and also to provide the person with greater

freedom in other environments as well. The issue becomes one of knowing how to do this, and a determinate science of behavior can increase freedom. Indeed, there is nothing novel to this thought, since effective psychiatrists and others interested in clinical problems have been increasing the patient's range of responses, his degree of freedom, his responsibility, and his effectiveness.

Freedom has often been implicitly equated with sloppiness of control, as was the case in the Austria of Dolfuss, which was popularly described as "dictatorship mitigated by sloppiness." Indeed, one implication of this implicit definition may underlie the objection to operant control, that by being efficient it is dictatorial. Closer examination, however, reveals that freedom may not be synonymous with sloppiness. The child who responds, "In just a minute, Daddy," when called to brush his teeth, may not be more free than one who responds immediately. He may be watching a television show whose reinforcements are controlling watching behavior. His behavior may be under effective environmental control. Fundamentally, the subject at issue between obeying the paternal command and not objeying it may not even be one of sloppy control versus good control but rather one of *whose* control is involved. In this sense, freedom is an irrelevant term, as it is in the case of freedom from physical laws.

However, if we are to examine the usage of the term, freedom, carefully, we may discover that a BBQ definition may, in the commonly used sense of the term, help us to preserve it. A person who is more free than another may have more types of alternate consequences contingent upon his differing behaviors and may, therefore, have more response alternatives than the other person. It is in this sense that a well-educated person, who can get support in a variety of ways, is freer than someone who can only dig ditches for a living. This definition of freedom is not incompatible with control of behavior and, by alerting us to the sources of reinforcement in a community, may alert us how to program our environment to maintain and even to extend freedom; it may make us effective *as well as* well-meaning.

SELF-CONTROL

A further extension of operant conditioning of human affairs involves self-control. The Greek maxim, "know thyself" can be translated behaviorally into: "Know what behaviors thou wantest from thyself, and know the conditions which optimize their occurrence, and set up these conditions." In this manner, Ferster, (Ferster, Nurnberger, and Levitt, 1962) was able to get obese nurses to reduce. Normally, when one reduces, the goading stimulus is fear of the consequences of overweight. As the overweight goes down, this goading stimulus is attenuated, finally being eliminated upon the completion of the crash program, and the person may start overeating again.

Rather than telling the nurses that they must *will* to reduce, the investigators analyzed the conditions which controlled their overeating and taught the nurses how to control these conditions. They were taught a very effective form of self-control. Similarly, I have been engaged in an attempt to apply such procedures to other forms of counselling for students whose study behaviors were inadequate to keep them in school and for marital pairs whose marital behaviors were inadequate to maintain a successful marriage. It is useless to tell people that they should be more decent to each other, since they know this already. New Year's resolutions, which are characterized by the will to change, are also characterized by their ineffectiveness. The will to come to work early expressed in such a resolution may be unsuccessful, but if an alarm clock is purchased—a simple change in the environment—the person may get up in the morning. The road to divorce is paved with good intentions. The cases I have worked with have involved people who have been adequate in many areas in their lives but have not exhibited the behaviors to make their marriage go. The procedures involved are basically training in the analysis of behavior and in attempting to have the individuals involved apply the analysis to the problem at hand. The significant environment here, of course, is the environment which each partner creates for the other. Counselling sessions become "research conferences" between counsellor and client, the subject being the expert in the content of his life, the behaviors he wants, and the conditions we can capitalize upon.

Two examples will be cited in the marital counselling situations. In the first case, the husband reported to me one day that the whole procedure would not work since his wife needed him less than he needed her; that is, the influence upon each other was not reciprocal. He was asked how he knew, and he said it was evident. He was then asked to restate this behaviorally, namely, that his wife was behaving in a certain way less than he behaved in that way, and was asked to specify the behaviors (BBQ) he was talking about. He then stated that she did not exhibit such dependency behaviors as asking him to do things for her. I asked, "When was the last time she asked you to do something for her?" He said, "Yesterday she asked me to change the burnt-out bulb in the kitchen." "Did you do this?" Answer: "No." "Well?" I said. The point then dawned on him that if he wanted such behaviors he was to reinforce them, and the classical way to maintain and establish dependency is to provide continual help. There ensued a discussion of needs, personality, and related inferences. "If by personality, all that is meant is my behavior, then my personality changes from one moment to the next, because my behavior changes," he stated. "I should hope so," I said. "Well, what is my true personality; what is the true me?" he asked. "Do you have a true behaviour?" I asked. He said: "Hummmmmmmmm, I don't—that is interesting," and he proceeded to take notes. Incidentally, I sat back and watched him take notes throughout, a reversal of the usual procedures.

The next week he came in and stated, "I did something last week that I

have never done before in my life. When I teach in classrooms, I am able to manage my classroom; but when I talk to tradespeople, I find I am very timid and allow myself to be cheated. Well, last week my carburetor gave out. I knew if I went to the garage they would make me buy a new one even though I have a one-year's guarantee. I sent my wife down to the garage instead. She is a real scrapper. She came back with a new carburetor without it costing us a cent. Why should I have to be all things to all men? In school I control things, but with tradespeople I don't. So what?"

Another case involved a husband and wife whose problem was the lack of affectionate behaviors on the part of the husband. One of her later comments to me was: "I am at my wits end as to how to shape his behavior. I don't know what reinforcements I have. The characteristic of a good reinforcement is that it can be applied immediately and is immediately consumed. I could withhold supper, but that is not a good reinforcer because I can't turn it off and on. I can't apply deprivation, because that's my problem. I don't know what to do." I mention this merely to illustrate how a problem may be formulated in these research conferences, in which subjects of the conferences are applying behavioral analysis to the problems on hand. Both husband and wife were fully in on the discussions, they tried out various procedures, and finally they, themselves, came up with the one which worked. Stated otherwise, they were the experts in the content of the marriage; I was simply a consultant on abstract procedures. Together we tried to make the procedures fit their particular terrain.

One of the local clinical psychologists discussed my counselling procedures with me and commented, "You know, I don't believe in marital counselling." I asked why not, and she stated, "Because I think that marital problems are merely symptomatic of a deeper underlying problem; their solution, for all you know, may involve breaking up the marriage." "Oh," I said. "Let me cite an abstract case: my garage door is stuck. I call in a carpenter to fix the door and leave him with the keys. When I return, I discover that my house has been dismantled and my lot chopped up, with a high rise apartment in one corner and a sunken garage underneath. I did not ask the carpenter to change my house; it was perfectly adequate the way it was. I only asked him to change the garage door. The carpenter's behavior is highly unethical and unwarranted. Fortunately, you are not as effective as the carpenter."

The aim in behavioral modification of the type we have been using is to alter those behaviors about which a contractual agreement has been made implicitly or explicitly. By being able to specify the behaviors in question, focus can be made upon those behaviors. One of our stuttering subjects, for example, was suicidal and had tried shock and other treatments to eliminate stuttering, without success. Within two weeks, in exact accord with the program utilized, she was reading in the booth without stuttering and was also able to read bedtime stories to her children. Her home life changed in accord.

Rather than the stuttering being a symptom of underlying disturbances, the other behavioral disturbances could be considered symptoms of stuttering! The term, symptom, can be defined behaviorally rather then mystically. When the dermatologist states that a skin rash is a symptom of a blood imbalance, he is stating that he will treat something other than the presenting complaint. Analogously, where a behavior is defined as a symptom, this implies that something else (possibly some other behavior) will be treated rather than the problem behavior. The BBQ may be applied to the problem in the following manner: What are the behaviors (or behavioral deficits) and the conditions which define the problem for us in this individual? What procedures do we have to utilize to alter them?

Assuming that we can develop remedial procedures to alter behavior, what are the implications for prevention? What about etiology? Cause and etiology are not necessarily scientifically synonymous. One of the marital patients started on his childhood, and was cut off. "But doesn't it affect me now?" he asked. "Look," I said, "a bridge with a load limit of three tons opens in 1903. The next day, a farmer drives eighteen tons over it; it cracks. The bridge collapses in 1963. What caused the collapse?" "The farmer in 1903," he said. "Wrong," I said, "the bridge collapses in 1963 because of the cracks that day. Had they been filled in the preceding day, it would not have collapsed. Let's discuss the cracks in your marriage." The same treatment will serve to put out a forest fire started by a match, lightning, or spontaneous combustion. To prevent a fire, though, do we have to know what started it? We can consider forest fires as maintained by a volatile combustible, oxygen, and a concentration of heat. Control of any of these will control the fire. These we can discover in the laboratory, but not necessarily in the forest, where a gust of wind may accentuate *or* attenuate the fire. We can now ask ourselves what specific forms these are likely to take in the natural ecology. Since forests are wood and grow in air, a likely source of control is the concentration of heat. This is likely to be in the form of common matches, campfires, lightning, or areas of undergrowth which build up heat. Accordingly, we can control matches and campfires, clean out undergrowth, watch for lightning, and thereby *prevent* forest fires. Analysis of behavior in terms of its maintaining variables may be used both for remediation and prevention.

With regard to the marital counselling and study counselling that we have been doing, the net outcome has been that the people involved have learned to lick their own problems and have learned to utilize procedures which may stand them in good stead in other areas of behavior. They began applying the procedures elsewhere in many ways, trying to shape others, like the beginning graduate student. If this does not define the self-enhancement and the self-actualization that Carl Rogers talks about, I don't know what does. Thus, "paradoxically," application of self-control procedures derived from controlled laboratory research can fulfill the aims of those clinical psychologists who pride themselves on effecting change through providing

greater freedom for the client. The notion that extension of operant conditioning to counselling involves manipulation of the patient, whereas a client-centered approach involves having the patient learn for himself, is an invalid distinction which ignores the fact that operant procedures can be used for self-control.

If this application of self-control procedures to counselling problems restores some human dignity to people who had lost self-confidence through the inability to control their own problems, the application of direct control procedures may have a similar effect. I am referring to the work of Ayllon and Azrin at Anna State Hospital, where a complete ward has been turned over to operant procedures. The investigators have drawn up lists of behaviors they want from the patients and behaviors which the patients like to engage in, and they make the latter contingent upon the former through a token system. The patient gets a token for brushing her teeth, making her bed, and so on. With these tokens, she can rent a pass to go out, buy cigarettes, get a better bed, and so on. The ward had lost its stinking schizophrenic smell. Choices, decisions, and dignity have now been restored to the patients; they no longer must await the whim of a nurse before they go outdoors, but can decide on their own.

This system was, of course, imposed upon the patients without their consent, but in this it does not differ from the current social mission of the hospital, which is to discharge the patients as cured, whether they want to be cured or not. The distinction is that the system works according to explicitly specifiable procedures. And choice and dignity have been restored to the patients by focus upon their behaviors, rather than upon some assumed underlying state.

The self-control process may be applied not only by the person to set up his own environment to get the behaviors that he wants, but may also be a solution to the problem of brain-washing. The person who learns to control his own behavior can also learn how to keep his behavior from being controlled and to apply counter-control. If the inquisitor doesn't possess this knowledge, then the captive who has been trained in it will have the upper hand. If the inquisitor has the knowledge but the captive doesn't, the latter will be putty. The race will be to the one who knows the most and possesses the greater means to apply the knowledge. When was it otherwise?

Accordingly, it seems to us at the Institute for Behavioral Research that it is quite vital to train people in the analysis of behavior, so that professionals in other disciplines may draw from it that which they find useful in their own area. We are attempting to program such a course at the Institute. This programmed course must not be confused with the programmed instruction which involves blanks in textbooks. Rather, the programmed course involves standard articles and chapters as well as programmed texts, laboratory exercises, discussions at stipulated points in the sequence, all of which constitute progression through the course. When the subject has gone through

so much, he earns the right to take up the instructor's time. This reinforcement works rather effectively. The basic philosophy involved here is that when one shapes a pigeon, one is guided in the application of the next step by the behavior of the pigeon in the preceding step. If the pigeon raises his head, he is reinforced; and if he lowers his head, there is no reinforcement. Where the pigeon controls the experimenter's behavior, laboratory control over the learning of pigeons is superb. Equally good learning on a human level also involves having the teacher govern his behavior by the progress of the student. In the laboratory, the payoff to the experimenter for being guided by the pigeon is the research report. Unfortunately, in the university, the payoffs to the instructor are usually not attached to being controlled by the behavior of the learner.

There is reciprocal control here. It is the experimenter who sets the criteria to be approached or the terminal behaviors he wishes from the learner. These terminal behaviors are the experimenter's BBQ definition of knowledge. To establish these behaviors, he must put himself under the control of the learner, modifying his own behaviors in accord with the learner's behaviors, so that the criterion behavior is shaped. There has been too much emphasis in discussing conditioning on control *over* the learner (or the patient) and not enough emphasis on control *by* the learner (or patient). Experimental analysis of behavior suggests that we be sensitive to such reciprocal control.

We are attempting to establish a program which incorporates these features, and the specification and progression of the *behaviors* we require of the students is basically the program of the course. The textual and other materials used are relevant only insofar as they contribute to the progression of the student's behavior toward the criterion behavior. We believe this emphasis upon behavior rather than content is the meaning underlying the progressive educator's statement that he is "interested in teaching the child rather than the subject matter."

As we stated earlier, it is our hope to make this program available to professionals in other areas so that they may draw from the available procedures developed in behavioral analysis those procedures which they consider applicable to their disciplines. What we are stating is that the physicist or the psychiatrist or the marital partner knows the content of his own area far better than we do. Further, he is on the spot to apply procedures when they are most critically effective. Hence, the program of extension. There is a reverse side to this program, which involves the contributions to behavior analysis from disciplines with different orientations and procedures for control.

BEHAVIOR TECHNOLOGY AND CONFORMITY

Modern technology now reverses rivers. Although the humorist likes to assert that highways now take up all available space and all rivers are dammed, in

actuality this is not so. Granted, stupidity and cupidity have had their say, but these are not inventions of modern technology. In general, we have constructed highways and dammed rivers where it has been socially useful and economically feasible to do so. I would suggest that when a technology of behavior is firmly established, the same principle will apply, namely, that we shall control those behaviors which we find it socially useful and economically feasible to control. We would certainly like to see our children come out of schools having learned what they are supposed to learn. We would like to see our prisoners rehabilitated and our mentally ill behaving appropriately.

The notion that behavioral technology will mean a prison state or manipulation of behavior on a total scale ignores some of the more recent developments in the experimental analysis of behavior and in self-control. When one starts to apply experimental analysis to practical problems, the procedures which develop in practice differ considerably from those which may be projected from a theoretical understanding.

Brave New World and *1984* project upon the future behaviors which are fundamentally like the behaviors of today. It is this anomaly which produces the irony and sting of these works. As literature, they may have merit, but as predictions of the future, their prophesies must be questioned. *Brave New World* depicts a society which is so technologically advanced that babies are reared in test tubes. This is a technology which is far beyond what we possess today, but not beyond the bounds of reason. A level of technology this advanced will contain stimuli that at present we can not even conceive of. If we assume behavior to be under stimulus control, as I do, the assumption that given all these novel stimuli of the future the behaviors that emerge are going to be the behaviors of today leads to a far more pessimistic view of the future of the human race than anything Huxley or Orwell could have dreamed of. If our behavior does not conform to the new stimuli but stays the same way it is today, we will become extinct more rapidly than did the dinosaurs. This point is missed by those who cite the paradox of who will control the controller. The controller will be controlled by his subjects, who will also be controlled by him, and the loop is never closed but is always subject to opening and revision by the new stimuli being explosively created by our expanding technology. Sociologists charge the Ford with being a major influence in the changed sexual mores of today—something certainly not foreseen by Ford nor by the sociologists. It will be recalled that the germ theory of disease rests upon the development of the microscope from the telescope, something alien to medicine. The behavior of tomorrow will be similar to the behavior of today to the extent that the controlling stimuli are similar; to the extent that these will change, behavior will change. Inasmuch as I cannot predict what future stimuli will be created, I can not predict what behavioral or societal developments will occur. I would suggest, however, that we keep our eyes open and try to understand what is going on, especially in the scientific community.

The notion that modern technology has produced mass conformity forgets the conformities produced by the absence of knowledge and by superstition. In the absence of good medicine, the children of a backward society may have straight, knock-kneed, or bowlegs of different heights and at picturesque angles. Given such picturesque and crippled legs, one can engage in only a very few locomotive behaviors. Given missing teeth, one can eat only mush. Given, however, modern technology, one can use one's straight legs to climb mountains and one's straight teeth to eat steak or mush. In a backward society, behavior is extremely predictable. The son of a peasant will be a peasant. How to keep his son down on the farm is a problem faced by farmers. In our society, among the most predictable people is the compulsive who washes his hands every five minutes. Applying behavioral analysis to get him out of the hospital will make his behavior predictably less predictable.

The issue has also been raised of responsibility, ethics, freedom, and man's concept of man if his behavior is under environmental control. I would submit that the issue of determinism is irrelevant to the issue of responsibility. The Puritan was a Calvinist and lived in a highly responsible world. One can imagine the Puritan chicken thief coming before a Puritan judge and claiming that he was not to blame, since a stern Deity had preordained that he steal the chicken. And one can imagine the judge stating with equal firmness that it hath also been written that he should be punished in such a manner that he would never sin again. Determinism and the use of consequences to alter behavior are not incompatible with each other. It is up to society to learn how to use consequences appropriately to minimize the likelihood of certain behaviors and to maintain others. If behavioral psychology does not allow the criminal the out of escaping the consequences of his act by referring to events which were beyond his control, neither does it allow the teacher to escape the consequences of his sloppy training procedures by placing the blame on the inabilities of his students. Rather, it places upon all of us the responsibility of trying to gain more knowledge in the area of behavior and trying to apply what we know.

In a recent science fiction story, a baby was given a revolver to play with. The analogy was modern man, with his advanced technology in physical sciences but with no control over his behavior. If the human race does have a future, it may be in the development of a science and technology of a behavior at least equal to that which we possess in the physical sciences. It should be pointed out that the use and misuse of any advance is *behavior*. If we can understand and control behavior, perhaps we can understand and control the misuse of other sciences. Whether or not this occurs in time is problematic, but at least it offers us some ray of hope.

The scientific analysis of behavior requires attention to scientific method and procedures, and its results are often surprising. They are especially surprising to those who equate control with automata and a concept of

mechanism which they can understand. The various physical and biological sciences have changed so radically in the past few years that one physicist has remarked that most of the major concepts he learned in college are now obsolete. While this has not yet occurred to this extent in the analysis of behavior, the likelihood that a literate person trained in the psychology of yesteryear can understand current developments is becoming increasingly remote. The two languages of C. P. Snow are advancing upon this area as well. This poses the danger that what is a genuine danger and requires social control will be unrecognized while that which is not a danger will be attacked. Such was the case with subliminal perception, where a discrepancy of two behaviors was related to the literately understandable concept of unconscious control. Such is the case with experimental analysis and control of ongoing behavior, where control is associated with the literately understandable concept of lack of freedom and dignity.

This discussion has mainly stressed the unjustified alarm over behavioral control. The *justified* alarm is occasioned by the growing existence of two languages in an area of vital concern to man—*his own behavior*. Much of the current alienation of the literate person from his culture of today may be related to a past history of ignoring or being ignorant of the developing sciences and their associated technologies. The literary culture is being increasingly shaped by stimuli they never created. If history is not to repeat, that is, if alienation is not to occur precisely in that area which has occupied so many of the considerable talents of the literate culture, namely, human behavior, communication is necessary. It is the possibility of the disruption of such communication that may provide justified alarm—not over behavioral control, but over the possibility of alienation from the developing analysis and technology of behavioral control.

The British scientist, Dingle, recently reported a paradox in science and its relation to society. He stated that philosophers discovered some time ago that when they used the same terms, these same terms often had different meanings. Accordingly, laboratories were established in which the terms were defined in a standard and limited way. Such limitations turned out, paradoxically, to be extremely applicable in understanding and controlling the limitless world outside the laboratory. The paradox resolves itself if we regard science as a representational system in which the scientist communicates representations of his observations. These representations are admittedly limitations. I would like to raise the argument that most communication involves representation and is therefore limited. In the scientific representational systems, we try to be explicit about the limitations that we impose upon ourselves. Other representational systems may assume that they are unlimited (or deal with the totality or the total personality or what have you), and yet others may acknowledge the fact that they are limited but do not attempt to make explicit the nature of their limitations. Given, now, two competing systems, both of them limited, but with one

of them having an awareness of its limitations and attempting to state them explicitly and the other either not aware of the fact that it is limited or unaware of what its limitations are, the race will obviously be to the system whose wielders know what they are doing. Science may be awkward, slow, bumbling, time-consuming, and narrow; but its contributions rest upon the difference mentioned. Through such awareness of his limitations, man has become a geological force which changes the course of rivers and a zoological force which changes the ecology. Through the application of scientific method to behavior, he is becoming a behavioral force which, hopefully, can be applied to the self-control of his own behavior.

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Contingencies of reinforcement in the design of a culture

B. F. Skinner

The world in which man lives has been changing much faster than man himself. In a few hundred generations, highly beneficial characteristics of the human body have become troublesome. One of these is the extent to which human behavior is strengthened by certain kinds of reinforcing consequences.

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It was once important, for example, that men should learn to identify nutritious food and remember where they found it, that they should learn and remember how to catch fish and kill game and cultivate plants, and that they should eat as much as possible whenever food was available. Those who were most powerfully reinforced by certain kinds of oral stimulation were most likely to do all this and to survive—hence man's extraordinary susceptibility to reinforcement by sugar and other foodstuffs, a sensitivity which, under modern conditions of agriculture and food storage, leads to dangerous overeating.

A similar process of selection presumably explains the reinforcing power of sexual contact. At a time when the human race was periodically decimated by pestilence, famine, and war and steadily attenuated by endemic ills and an unsanitary and dangerous environment, it was important that procreative behavior should be maximized. Those for whom sexual reinforcement was most powerful should have most quickly achieved copulation and should have continued to copulate most frequently. The breeders selected by sexual competition must have been not only the most powerful and skillful members of the species but those for whom sexual contact was most reinforcing. In a safer environment the same susceptibility leads to serious overpopulation with its attendant ills.

The principle also holds for aggressive behavior. At a time when men were often plundered and killed, by animals and other men, it was important that any behavior which harmed or frightened predators should be quickly learned and long sustained. Those who were most strongly reinforced by evidences of damage to others should have been most likely to survive. Now, under better forms of government, supported by ethical and moral practices which protect person and property, the reinforcing power of successful aggression leads to personal illness, neurotic and otherwise, and to war—if not total destruction.

Such discrepancies between man's sensitivity to reinforcement and the contribution which the reinforced behaviors make to his current welfare raise an important problem in the design of a culture. How are we to keep from overeating, from overpopulating the world, and from destroying each other? How can we make sure that these properties of the human organism, once necessary for survival, shall not now prove lethal?

THREE TRADITIONAL SOLUTIONS

One solution to the problem might be called the voluptuary or sybaritic. Reinforcement is maximized while the unfortunate consequences are either disregarded—on the principle of eat, drink, and be merry for tomorrow we die—or prevented. Romans avoided some of the consequences of overeating, as an occasional neurotic may do today, by using the vomitorium. A modern

solution is nonnutritious food. Artificial sweeteners have an effect on the tongue similar to that of ripe fruit, and we can now be reinforced for eating things which have fewer harmful effects. The sybaritic solution to the problem of sexual reinforcement is either irresponsible intercourse or the prevention of consequences through contraception or nonprocreative forms of sex. Aggressive behavior is enjoyed without respect to the consequences in the donnybrook. Some consequences are avoided by being aggressive towards animals, as in bearbaiting and other blood sports, or vicariously aggressive toward both men and animals, as in the Roman circus or in modern body sports and games. (Broadcasters of professional football and prize fights often use special microphones to pick up the thud of body against body.)

It is not difficult to promote the sybaritic solution. Men readily subscribe to a way of life in which primary reinforcers are abundant, for the simple reason that subscribing is a form of behavior susceptible to reinforcement. In such a world one may most effectively pursue happiness (or, to use a less frivolous expression, fulfill one's nature), and the pursuit is easily rationalized: "Nothing but the best, the richest and fullest experience possible, is good enough for man." In these forms, however, the pursuit of happiness is either dangerously irresponsible or deliberately nonproductive and wasteful. Satiation may release a man for productive behavior, but in a relatively unproductive condition.

A second solution might be called, with strict attention to etymology, the puritanical. Reinforcement is offset by punishment. Gluttony, lust, and violence are classified as bad or wrong (and punished by the ethical group), as illegal (and punished by the government), as sinful (and punished by religious authorities), or as maladjusted (and punished by those therapists who use punishment). The puritanical solution is never easy to "sell", and it is not always successful. Punishment does not merely cancel reinforcement; it leads to a struggle for self-control which is often violent and time consuming. Whether one is wrestling with the devil or a cruel superego, there are neurotic by-products. It is possible that punishment sometimes successfully "represses" behavior and the human energies can then be redirected into science, art, and literature, but the metaphor of redirection of energy raises a question to which we must return. In any event the puritanical solution has many unwanted by-products, and we may well explore other ways of generating the acceptable behaviors attributed to it.

A third solution is to bring the body up to date. Reinforcing effects could conceivably be made commensurate with current requirements for survival. Genetic changes could be accelerated through selective breeding or possibly through direct action on the germ plasm, but certain chemical or surgical measures are at the moment more feasible. The appetite-suppressing drugs now available often have undesirable side effects, but a drug which would make food less reinforcing and therefore weaken food-reinforced behavior would be widely used. The possibility is not being overlooked by

drug manufacturers. Drugs to reduce the effects of sexual reinforcement—such as those said to be used, whether effectively or not, by penal institutions and the armed services—may not be in great demand, but they would have their uses and might prove surprisingly popular. The semistarvation recommended in some religious regimens as a means of weakening sexual behavior presumably acts through chemical changes. The chemical control of aggressive behavior—by tranquilizers—is already well advanced.

A physiological reduction in sensitivity to reinforcement is not likely to be acceptable to the sybarite. Curiously enough, the puritan would also find it objectionable because certain admirable forms of self-control would not be exhibited. Paraphrasing La Roche-foucauld, we might say that we should not give a man credit for being tranquil if his aggressive inclinations have been suppressed by a tranquilizer. A practical difficulty at the moment is that measures of this sort are not specific and probably undercut desirable reinforcing effects.

A FOURTH SOLUTION

A more direct solution is suggested by the experimental analysis of behavior. One may deal with problems generated by a powerful reinforcer simply by changing the contingencies of reinforcement. An environment may be designed in which reinforcers which ordinarily generate unwanted behavior simply do not do so. The solution seems reasonable enough when the reinforcers are of no special significance. A student once defended the use of punishment with the following story. A young mother had come to call on his family, bringing her five-year-old son. The boy immediately climbed onto the piano bench and began to pound the keys. Conversation was almost impossible and the visit a failure. The student argued for the puritanical solution: he would have punished the child—rather violently, he implied. He was overlooking the nature of pianos. For more than two hundred years talented and skillful men have worked to create a device which will powerfully reinforce the behavior of pressing keys. (The piano, is, indeed, an "eighty-eight lever box." It exists solely to reinforce the pressing of levers—or the encouraging of others to press them.) The child's behavior simply testified to the success of the piano industry. It is bad design to bring child and piano together and then punish the behavior which naturally follows.

A comparable solution is not so obvious when the reinforcers have strong biological significance because the problem is misunderstood. We do not say that a child possesses a basic need to play the piano. It is obvious that the behavior has arisen from a history of reinforcement. In the case of food, sex, and violence, however, traditional formulations have emphasized supposed internal needs or drives. A man who cannot keep from overeating suffers from strong internal stimulation which he easily mistakes for the

cause (rather than a collateral effect) of his uncontrollable behavior, and which he tries to reduce in order to solve his problem. He cannot go directly to the inner stimulation, but only to some of the conditions responsible for it—conditions which, as he puts it, "make him feel hungry." These happen also to be conditions which "make him eat." The easiest way to reduce both the internal stimulation and the strength of the behavior is simply to eat, but that does not solve the problem. In concentrating on other ways of changing needs or drives, we overlook a solution to the behavioral problem.

What a man must control to avoid the troublesome consequences of oral reinforcement is the behavior reinforced. He must stop buying and eating candy bars, ordering and eating extra pieces of cake, eating at odd times of the day, and so on. It is not some inner state called hunger but overeating which presents a problem. The behavior can be weakened by making sure that it is not reinforced. In an environment in which only simple foods have been available a man eats sensibly—not because he must, but because no other behavior has ever been strengthened. The normal environment is of a very different sort. In an affluent society most people are prodigiously reinforced with food. Susceptibility to reinforcement leads men to specialize in raising particularly delicious foods and to process and cook them in ways which make them as reinforcing as possible. Overanxious parents offer especially delicious food to encourage children to eat. Powerful reinforcers (called "candy") are used to obtain favors, to allay emotional disturbances, and to strengthen personal relations. It is as if the environment had been designed to build the very behaviors which later prove troublesome. The child it produces has no greater "need for food" than one for whom food has never been particularly reinforcing.

Similarly, it is not some "sexuality" or "sex drive" which has troublesome consequences but sexual behavior itself, much of which can be traced to contingencies of reinforcement. The conditions under which a young person is first sexually reinforced determine the extent as well as the form of later sexual activity. Nor is the problem of aggression raised by a "death instinct" or "a fundamental drive in human beings to hurt one another" (Menninger, 1964), but rather by an environment in which human beings are reinforced when they hurt one another. To say that there is "something suicidal in man that makes him enjoy war" is to reverse the causal order; man's capacity to enjoy war leads to a form of suicide. In a world in which a child seldom if ever successfully attacks others, aggressive behavior is not strong. But the world is usually quite different. Either through simple neglect or in the belief that innate needs must be expressed, children are allowed and even encouraged to attack each other in various ways. Aggressive behavior is condoned in activities proposed as "a moral equivalent of war." It may be that wars have been won on the playing fields of Eton, but they have also been started there, for a playing field is an arena for the reinforcement of

aggressive action, and the behaviors there reinforced will sooner or later cause trouble.

The distinction between need and reinforcement is clarified by a current problem. Many of those who are trying to stop smoking cigarettes will testify to a basic drive or need as powerful as those of hunger, sex, and aggression. (For those who have a genuine drug addiction, smoking is reinforced in part by the alleviation of withdrawal symptoms, but most smokers can shift to nicotine-free cigarettes without too much trouble. They are still unable to control the powerful repertoire of responses which compose smoking). It is clear that the troublesome pattern of behavior—"the cigarette habit"—can be traced, not to a need, but to a history of reinforcement because there was no problem before the discovery of tobacco or before the invention of the cigarette as an especially reinforcing form in which tobacco may be smoked. Whatever their other needs may have been, our ancestors had no need to smoke cigarettes, and no one has the need today if, like them, he has never been reinforced for smoking.

The problem of cigarette smoking has been approached in the other ways we have examined. Some advertising appeals to the irresponsible sybarite: buy the cigarette that tastes good and inhale like a man. Other sybaritic smokers try to avoid the consequences; the filter is the contraceptive of the tobacco industry. The puritanical solution has also been tried. Cigarettes may be treated so that the smoker is automatically punished by nausea. Natural aversive consequences—a rough throat, a hoarse voice, a cigarette cough, or serious illness—may be made more punishing. The American Cancer Society has tried to condition aversive consequences with a film, in color, showing the removal of a cancerous lung. As is often the case with the puritanical solution, aversive stimuli are indeed conditioned—they are felt as "guilt"—but smoking is not greatly reduced. A true nicotine addiction might be controlled by taking nicotine or a similar drug in other ways, but a drug which would be closer to the chemical solution promised by anti-appetite, anti-sex, and anti-aggression drugs would specifically reduce the effect of other reinforcers in smoking. All these measures are much more difficult than controlling the contingencies of reinforcement.

(That there is no need to smoke cigarettes may be denied by those who argue that it is actually composed of several other kinds of needs, all of them present in nonsmokers. But this is simply to say that cigarette smoking is reinforced by several distinguishable effects—by odor, taste, oral stimulation, vasoconstriction in the lungs, "something to do with the hands," appearing to resemble admired figures, and so on. A nonsmoker has not come under the control of a particular combination of these reinforcers. If any one should cause trouble on its own or in some other combination, it could be analyzed in the same way.)

MAKING CONTINGENCIES LESS EFFECTIVE

The problems raised by man's extraordinary sensitivity to reinforcement by food, sexual contact, and aggressive damage cannot be solved, as the example of cigarette smoking might suggest, simply by removing these things from the environment. It would be impossible to change the world that much, and in any case the reinforcers serve useful functions. (One important function is simply to encourage support for a culture. A way of life in which food, sex, and aggression were kept to a bare minimum would not strongly reinforce those who adopted it nor discourage defections from it.) The problem is not to eliminate reinforcers but to moderate their effects. Several possible methods are suggested by recent work in the experimental analysis of behavior. The mere frequency with which a reinforcer occurs is much less important than the contingencies of which it is a part.

We can minimize some unwanted consequences by preventing the discovery of reinforcing effects. The first step in "hooking" a potential heroin addict is to give him heroin. The reinforcer is not at first contingent on any particular form of behavior; but when its effect has been felt (and, particularly, when withdrawal symptoms have developed), it can be made contingent on paying for the drug. Addiction is prevented simply by making sure that the effect is never felt. The reinforcing effects of alcohol, caffeine, and nicotine must be discovered in a similar way, and methods of preventing addiction take the same form. The process underlies the practice of giving free samples in food markets; customers are induced to eat small quantities of a new food so that larger quantities may be made contingent on surrendering money. Similar practices are to be found in sexual seduction and in teaching the pleasures of violence.

Reinforcers are made effective in other ways. Stimuli are conditioned so that they become reinforcing; aversive properties are weakened through adaptation so that reinforcing properties emerge with greater power (a "taste" is thus acquired); and so on. Processes of this sort have played their part in man's slow discovery of reinforcing things. It has been, perhaps, a history of the discovery of human potentialities, but among these we must recognize the potentiality for getting into trouble. In any case, the processes which make things reinforcing need to be closely scrutinized.

The excessive consummation which leads to overweight, overpopulation, and war is only one result of man's sensitivity to reinforcement. Another, often equally troublesome, is an exhausting preoccupation with behavior which is only infrequently consummated. A single reinforcement may generate and maintain a great deal of behavior when it comes at the end of a sequence or chain of responses. Chains of indefinite length are constructed in the laboratory by conditioning intermediate reinforcers. Teachers and

others use the same method for many practical purposes. We may assume that something of the sort has occurred whenever we observe long chains. The dedicated horticulturalist is ultimately reinforced, say, by a final perfect bloom, but all the behavior leading up to it is not thereby explained; intermediate stages in progressing toward a final bloom must in some way have become reinforcing. In order for early man to have discovered agriculture, certain early stages of cultivation must first have been reinforced by accident or at least under conditions irrelevant to the eventual achievement.

The reinforcers we are considering generate many sequences of this sort with troublesome results. Ultimate reinforcement is often ridiculously out of proportion to the activity it sustains. Many hours of careful labor on the part of a cook lead at last to brief stimulation from a delicious food. A good wine reinforces months or years of dedicated care. Brief sexual reinforcement follows a protracted campaign of seduction (see, for example, Choderlos de Laclos's *Les liaisons dangereuses* or Kierkegaard's *The Seducer*). The campaign of the dedicated aggressor, domestic or international, is often similarly protracted and suggests a long history in which a chain has been built up. Problems of this sort can be solved simply by breaking up the conditions under which long chains are formed.

Another kind of exhausting preoccupation is due to intermittent reinforcement. A single form of response is repeated again and again, often at a very high rate, even though only infrequently reinforced. Activities such as reading magazines and books, going to the theatre, and watching television are reinforced on so-called "interval" schedules. So-called "ratio" schedules are exemplified by piece-rate pay in industry and by gambling systems and devices. (Ratio schedules are so powerful that their use is often restricted or controlled by law.) Large quantities of behavior are generated by such schedules only when they have been carefully programmed. Reinforcement is at first relatively frequent, but the behavior remains strong as the frequency is reduced. Thus, a television program grows less and less reinforcing as the writer runs out of themes or as the viewer no longer finds the same themes interesting, but one who has followed a program from the beginning may continue to watch it long after reinforcements have become quite rare. The dishonest gambler prepares his victim by steadily "stretching" the mean ratio in a variable ratio schedule. Eventually the victim continues to play during a very long period without reinforcement.

There are many natural systems which "stretch" ratios. As addiction develops, the addict must take more and more of a drug (and presumably work harder and harder to get it) to achieve a given effect. To the extent that novelty is important, all reinforcers grow less effective with time. The gourmet is less often reinforced as familiar foods begin to cloy. The ratio schedule of sexual reinforcement is automatically stretched by satiation. The enormities suffered by the unfortunate Justine in de Sade's story suggest that her many persecutors were being reinforced on ratio schedules severely strained by both

aging and sexual exhaustion. Frank Harris has suggested, in his biography of Oscar Wilde (1916), that the word "lead" in "lead us not into temptation" is an unconscious recognition of the progression through which more and more troublesome forms of behavior are approached. Unwanted consequences are averted in all such cases by breaking up the programs through which infrequent reinforcement comes to sustain large quantities of behavior.

ARRANGING USEFUL CONTINGENCIES

We are usually interested—for example, in education—in getting the greatest possible effect from weak reinforcers in short supply. The problem here is just the reverse—we are to minimize the effect of reinforcers which are all too abundant and powerful. Hence, instead of systematically building up long chains of responses, we prevent their formation, and instead of constructing programs which make strained schedules effective we break them up. We can use the same procedures in the more familiar direction, however, in another solution to our problem. Reinforcers can be made contingent on productive behavior to which they were not originally related. Soldiers have often been induced to fight skillfully and energetically by arranging that victory will be followed by the opportunity to plunder, rape, and slaughter. It has always been particularly easy for the barbarian to mount an attack on a more advanced civilization which emphasizes the delectations of food and sex. It has been said, for example, that the wines of Italy (and presumably her well-groomed and beautiful women) made Rome particularly vulnerable. All governments make aggressive damage to an enemy especially reinforcing to their soldiers with stories of atrocities. Religious visions of another world have been made reinforcing in the same modes. Many of the offerings to the gods portrayed in Egyptian temples are edible, and Greek and Roman gods were distinguished by their taste for ambrosia and nectar, although less advanced civilizations have looked forward only to a happy hunting ground. Sex has its place in the Muslem heaven where men may expect to enjoy the attention of beautiful virgin Huris, and some theologians have argued that one of the attractions of the Christian heaven is the spectacle of sinners being tormented in hell—a spectacle which, as portrayed for example in the *Inferno*, competes successfully with the Roman circus at its most violent.

Marriage is often described as a system in which unlimited sexual contact with a selected partner is contingent on nonsexual behavior useful to the culture—such as supporting and managing a household and family and, following St. Paul's famous principle, foresaking sexual activity elsewhere. Women have often raised moral standards with practices which were merely carried to an extreme by Lysistrata. Educators use the basic reinforcers rather timidly. Erasmus (1529) advocated cherries and cakes in place of the cane in teaching children Greek and Latin, but he was the exception rather

than the rule. Homosexual reinforcement was explicit in Greek education, however, and a sadistic or masochistic violence has supported corporal punishment and competitive arrangements among students down to modern times. Economic transactions characteristically involve food, sex, and aggression since money as a generalized reinforcer derives much of its power when exchanged for them. In the nineteenth century it was expected that wages would be exchanged primarily for food, and charity was opposed on the grounds that the industrial system needed a hungry labor force. Better working conditions have made other reinforcers effective, but many of them are still related to sex and aggression.

Our reinforcers have, of course, a special place in art, music, and literature. Their place in science is not always obvious. Max Weber has argued, indeed, that the scientist is a product of the puritanical solution —profiting, for example, from the scrupulous or meticulous concern for exact detail generated by aversive consequences (the etymologies of *scrupulous* and *meticulous* show punitive origins). Feuer (1963) has recently shown, however, that almost all outstanding men in science have followed a "hedonist ethic."

A solution to our problem in which food, sex, and aggression are made contingent on useful forms of behavior to which they are not naturally related has much to recommend it. It should be acceptable to the sybarite because he will not lack reinforcement. It should also assuage the puritan, not only because objectionable consequences which seem to call for punishment have been attenuated but because a man must work for the reinforcers he receives. It should not require any change in human behavior through chemical, surgical, or even genetic means, since a natural sensitivity to reinforcement is now useful rather than troublesome.

The solution has not yet been satisfactorily worked out, however. The contingencies of positive reinforcement arranged by governmental and religious agencies are primitive, and the agencies continue to lean heavily on the puritanical solution. Economic reinforcement is badly programmed. Wage systems only rarely make effective use of positive reinforcement. In practice, wages simply establish a standard from which the worker can be cut off by being discharged. The control is aversive and the results unsatisfactory for both the employer (since not much is done) and the employee (since work is still work). Education is still largely aversive; most students study mainly in order to avoid the consequences of not studying. In short, some of the most powerful forces in human behavior are not being effectively used.

And for good reason. We are only beginning to understand how reinforcement works. The important things in life seem to be food, sex, and many other pleasant, enjoyable, and satisfying stimuli. These are the things which define happiness. They are the "good" things which contribute to the greatest good of the greatest number. They characterize human purpose, for they are among the things men live *for*. When we design a better world, either

utopian or theological, we make sure that there will be an abundant supply of them. We thus go directly to the reinforcers and are no doubt reinforced for doing so. We overlook a much more important consideration—the ways in which these wonderful things are contingent on behavior.

The concept of drive or need is particularly at fault here. We neglect contingencies of reinforcement because we seek solutions to all our problems in the satisfaction of needs. "To each according to his need" is the avowed goal of both an affluent society and a welfare state. (The principle is scriptural. St. Augustine discussed it long before St. Karl.) If those who seem to have everything are still not happy, we are forced to conclude that there must be less obvious needs which are unsatisfied. Men must have spiritual as well as material needs—they must need someone or something beyond themselves to believe in, and so on—and it is because these needs are unfulfilled that life seems so often empty and man so often rootless. This desperate move to preserve the concept of need is unnecessary because a much more interesting and fruitful design is possible.

Men are happy in an environment in which active, productive, and creative behavior is reinforced in effective ways. The trouble with both affluent and welfare societies is that reinforcers are not contingent on particular forms of behavior. Men are not reinforced for doing anything and hence they do nothing. This is the "contentment" of the Arcadian idyll and of the retired businessman. It may represent a satisfaction of needs, but it raises other problems. Those who have nothing important to do fall prey to trivial reinforcers. When effectively scheduled, even weak reinforcers generate strong, compulsive, repetitive behavior which ultimately proves aversive. Only when we stop using reinforcers to allay needs can we begin to use them to "fulfill man's nature" in a much more important sense.

Contingencies of reinforcement are far more important than the reinforcers they incorporate, but they are much less obvious. Only very recently, and then only under rigorous experimental conditions, have the extraordinary effects of contingencies been observed. Perhaps this explains why it has not been possible to design effective contingencies simply with the help of common sense or of practical skill in handling people or even with the help of principles derived from scientific field observations of behavior. The experimental analysis of behavior thus has a very special relevance to the design of cultures. Only through the active prosecution of such an analysis, and the courageous application of its results to daily life, will it be possible to design those contingencies of reinforcement which will generate and maintain the most subtle and complex behavior of which men are capable.

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INDEX

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